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FLIGHT

MAY 13 1936

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writes Tommy Rose

The Aerodrome,
Croydon, Surrey.
9th March, 1936.

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FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

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War to the Knife?

THE report of the Maybury Committee is still awaited, but, none the less, Railway Air Services have published a bold and comprehensive programme of internal air services for the coming summer. Their routes are spreading over most of the country, and they offer a frequency of service on most of the routes which will add greatly to the attractions of air transport. The scheme shows little evidence of rationalisation; on the contrary, Railway Air Services are openly entering into competition with other air companies on several of the routes, and in particular with the British Airways group. Air transport is an infant industry, and competition is not good for infant industries, though it admittedly has a stimulating effect once a business has become well established. Many of us had hoped that the report of the Maybury Committee would have shown the way to some form of rationalisation which would have obviated a war to the knife between inland air transport companies. As yet there is all too little traffic clamouring for air transport, and it is too much to hope that more than one company will be able to make a profit by plying on any given route within the British Isles.

Before attempting to come to any conclusions as to whether this programme of Railway Air Services ought to be applauded or regretted, certain considerations should be taken into account. Imperial Airways hold a proportion of the shares in Railway Air Services, and Imperial Airways receive a Government subsidy in respect of some, but not all, of their overseas services. British Airways likewise have a Government subsidy for their overseas service to Scandinavia, though the two enterprises are not comparable in magnitude. Some people object to the idea of a subsidised company entering into competition with unsubsidised concerns even on novel routes for which the former get no subsidy.

It should also be remembered that Sir Francis Shelmerdine, in his recent lecture to the Royal United Service Institution, admitted that most of the inland air transport companies had been losing money. One cannot withhold sympathy from those plucky pioneers, but one must remember that a company which is losing money cannot continue its operations indefinitely. Sooner or later it must disappear in any case, and so there is the less cause to grieve if its demise is hastened by the competition of a large concern which has a good chance of making profits and so of continuing to serve the public. A small company can only live by making a very substantial profit on every seat sold. A large company can afford to be content with a much smaller profit on each seat when it daily sells a large number of seats.

Two Questions

Welcome or otherwise to this ambitious scheme of Railway Air Services should be based on the answers to two questions: (1) What is best for the interests of the travelling public, and (2) what is best for the cause of inland air transport? The answer to the first must be that the public will benefit by the operations of a company which has large resources behind it, which starts with all the experience of traffic which the four big railway companies can supply, and which has all the resources of Imperial Airways in the way of repairs at its disposal. British Airways can also command considerable resources and experience, and may be able to put up a good fight for a share of the not too plentiful traffic. The answer to the second question must be that air transport stands to gain by working in co-operation with such a highly organised system of ground transport as has been built up by the four big railway companies, and would stand to lose heavily

if it entered into direct competition with such a system. On the whole, therefore, one can only feel glad that a scheme of operations on a large scale has been decided upon by a company which has the ability to carry it through. The scheme offers to the public not only many routes, but considerable frequency of service, and all that backing which gives good assurance that an air journey will be concluded safely and satisfactorily. These are the conditions which should encourage the British public to take to the aeroplane as a normal means of travel. The Post Office has already recognised it as a normal means of sending letters about the country. If the result of large-scale operations is to reduce the fares, as it is very much to be hoped will be the case, the public will still further benefit, and air transport itself will reap the advantages of the consequent popularity of air travel.

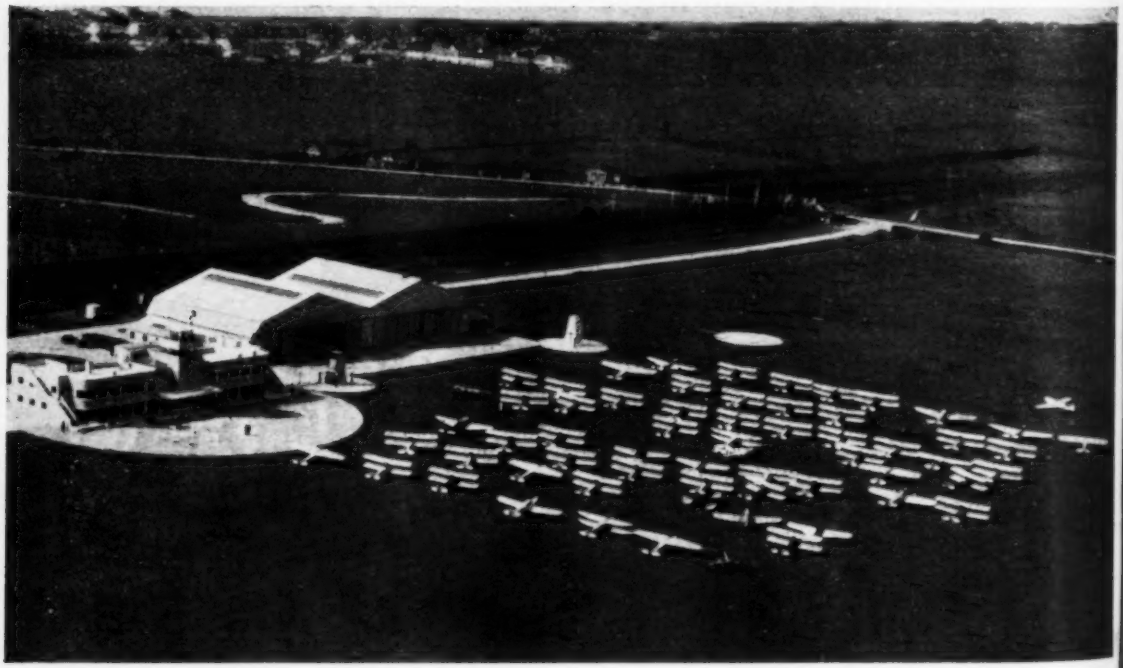
It is apparently too late to prevent competition between two large companies, which may prove very harmful to one or the other, yet we may still hope that means may be found to preserve such of the smaller companies as have been making good and deserve to survive. If they must give way to the cause of concentration of effort, may it be on such terms as will give an adequate reward to the pluck of their founders.

Ship-borne Aircraft

OF fifteen capital ships in the Royal Navy, ten are not equipped for carrying aircraft, and out of fifty-six cruisers there are thirty-six likewise innocent of catapults. Of the twenty which are so equipped, few carry more than one machine. These are rather serious figures, all the more so when it is realised that in the last two years the increase in the number of warships equipped with catapults has only been five.

It certainly seems that there is something wrong here, but it is not easy to decide who is to blame for the slow rate of progress and the present disturbing state of affairs. Some critics are inclined to blame the arrangement which divides responsibility for the Fleet Air Arm between the Admiralty and the Air Ministry, but in this case such a criticism is not justified. The Admiralty quite rightly pays practically all the cost of the Fleet Air Arm by way of an appropriation in aid to the Air Estimates. It follows that the Admiralty can order as many aircraft, as many flights, and as many squadrons as it will and can pay for. If the money is lacking to bring the Air Arm up to the standard which the Admiralty deems necessary, the blame must be laid on the Treasury—that is to say, on the policy of the whole Cabinet. No case has ever come to light since 1919 (when the Navy's desire for airships could not be gratified) of the Admiralty indenting on the Air Ministry for aircraft or formations of aircraft and being met with a refusal. During the present period of air expansion there may be delays in delivery, because the industry is now overwhelmed with orders and has not yet fully adapted itself to the new situation. Delay, however, is not the same thing as refusal, and, in any case, the present abnormal conditions have only recently arisen, and arguments based on them do not apply to past years.

The fact is that it is useless for the Admiralty to order more aircraft until the ships are able to accommodate them. If a capital ship or a cruiser has no catapult, it is useless to present it with a seaplane. It is a matter for the Admiralty, not for the Air Ministry.



IT'S NICE TO GET UP IN THE MORNING . . . Everyone voted the "dawn patrol" at Shoreham last week-end to be one of the best things of its kind yet provided for the entertainment—and nourishment—of enthusiastic private pilots. Of sixty-five "attackers" from various clubs only four managed to land without being intercepted, thus becoming eligible for free eggs and bacon.

The Outlook

A Running Commentary on Air Topics

Cowling and Cooling

THE review of aero engine cowling and cooling which appeared in *Flight* of April 16, and which is continued this week, draws attention to the very remarkable progress which has been made in recent years in securing adequate cooling of air-cooled engines without introducing extra drag; in fact, modern engine cowls have been developed which reduce the cooling drag to a very small percentage of the horse-power. The subject is of interest in showing how difficulties arising out of improvements in one direction are, in time, overcome by developments in another direction.

The old rotary engine scored by the very smooth running which resulted from the pronounced flywheel effect of its rotating parts, but it suffered from many disadvantages, one of these being the large percentage of power absorbed in whirling the crank case and cylinders around. There was an obvious limit to the size it was possible to make a rotary, and the stationary radial came along to replace it.

Early radials were somewhat feeble, and of teething troubles they had their share. In time, however, the radial triumphed, and it has now been developed to a degree of perfection which not even its staunchest advocates could have foreseen in the beginning. For a time the radial was reproached with its high drag. Modern cowling methods have reduced the drag to a very low figure, and at the same time the introduction of controlled cooling has ensured sufficient cooling during the climb without excessive drag at high speed in level flight. In fact, Dr. Douglas pointed out, in a lecture to the R.Ae.S. last year, that it was conceivable that on very fast aircraft the cooling air could be made to add to the propulsive force instead of to the drag. That ideal has not yet been reached, but great progress has been made. In this connection it is worth remembering that, although cooling drag may be reduced almost to vanishing point, form drag still remains with us, so that the small engine and the engine of low frontal area is still very much to be desired.

The Noise Nuisance

COMPLAINTS about the noise of aeroplanes are nothing new, and lately the Anti-Noise League has been in communication with the Air Ministry on the subject. Complaints from hospitals and sick persons are one thing; such complaints deserve the utmost sympathy, and wherever possible steps are taken to save the sufferers from the nuisance. In most other cases it is hard to avoid the conclusion that many of the objectors are unduly fussy, and object to the noise of aeroplanes simply because aeroplanes are new-fangled things of which they have not yet come to approve. The noise in the neighbourhood of a busy airport is not so objectionable as the noise of a railway station, and yet the vicinities of all the big stations in London, Birmingham, and other towns are thronged with houses. The noise there is an old noise, and people have grown up accustomed to it. The clanking of a tramline outside the front door would be far more nerve-racking, one would imagine, than the occasional, or even frequent, musical hum of an aero engine; but the one is old and the other new. How the dwellers in "ribbon-development" houses along an arterial road can support the incessant passing of motor cars is one of the mysteries of modern life, but such houses are usually snapped up before the builders have done with them. One can only conclude that the reason of the outcry against the noise of aeroplanes is its novelty, and, if that is so, time will provide a fairly speedy solution of the problem. Unnecessary low flying over populous areas is a crime, and for other reasons than the noise it must be, and will be, stamped out. But to the noise of legitimate flying the next generation will have grown up quite indifferent.

The City's Airport

THOUGH the final decision is not known at the time of writing, the scheme for building a City of London Airport at Fairlop, near Ilford, Essex, seems to have been examined pretty thoroughly since the public inquiry held last August by the Ministry of Health, when the relative merits of the site as a housing estate and as an aerodrome were discussed.

The cost is estimated at £600,000, which, spread as a loan over sixty years, would represent less than a penny rate for the City. Technically, the site has some sound claims, notably on the score of its level nature and good approaches. From the meteorological aspect, there is less to recommend it, for, with the prevailing south-west wind, it will spend much of the year under London's smoke pall; the Air Ministry, however, does not consider this sufficient to outweigh the advantages.

Most important of all, perhaps, is the question of access. It is said that the London Passenger Transport Board has schemes by which tube railways will serve the new airport. This is admirable—provided that the traffic will be handled in such a manner that strangers just landed from afar do not find themselves and their luggage swept in "Hammersmith all stations" trains into the maëlstrom of the City rush-hour. In view of the newest raids on the Road Fund one cannot view with any great enthusiasm the prospect of the alternative route—the thirteen-odd miles by road to the West End. The road to Croydon Airport is an *autostrada* compared with the tram-infested, cobble-stoned *via dolorosa* which straggles interminably out to Ilford; nor are the alternative routes to this part of the world much better.

Returning Hospitality

AMONG the 500 or so private owners of aircraft in this country there can be few who have not, at some time or other, enjoyed the most charming hospitality from other private owners when touring abroad. In many cases the friendliness and assistance have been almost embarrassing when one realised that opportunities to reciprocate were few and far between. Private owners are reminded that such an opportunity now occurs in connection with the "Week-end Aerien," which the Royal Aero Club is planning for July 23-25. More than 250 private owners, representing seventeen countries, have been invited, and it is the intention that the foreign guests should incur no expense whatever during their stay in England. The arrangements are in the hands of a Private Owners and Hospitality Committee appointed by the Royal Aero Club, and it is estimated that a sum of approximately £2,500 will be required.

It is hoped to make the Week-end Aerien the greatest gathering of European owner-pilots ever held, and British private owners will certainly welcome this opportunity to assist in entertaining foreign visitors, among whom they will doubtless find many old friends and meet many new. Contributions should be sent to the Secretary of the Royal Aero Club.

COWLING and COOLING

Part II. "Baffling" Problems Solved: The Advent of Controlled Cooling

How "H"-type Engines are Cowled and Cooled

(*Continued from "Flight" of April 16, 1936.*)

ONE of the most acceptable contributions made to international aviation by the American National Advisory Committee for Aeronautics is the N.A.C.A. cowling for radial engines. This cowling has come into prominence during the past three or four years, and in one form or another features on a very large proportion of modern radial-engined military and commercial aeroplanes. There are a number of current variations, but in no guise should the N.A.C.A. cowling be confused with the deep-chord Townend ring which, from some points of view, may appear similar.

In its original form the cowling, mounted on an American single-seater fighter, gave encouraging results, and in its essentials resembled the latest and most highly developed types now in use. Basically it was a long-chord ring with a nose-piece which curved over in the form of a lip, leaving a circular opening of comparatively small diameter for the admission of the cooling air which flowed past the cylinders and out of an annular slot at the rear. The exterior, of course, was designed to offer as little resistance as possible to the flow of air over the fuselage.

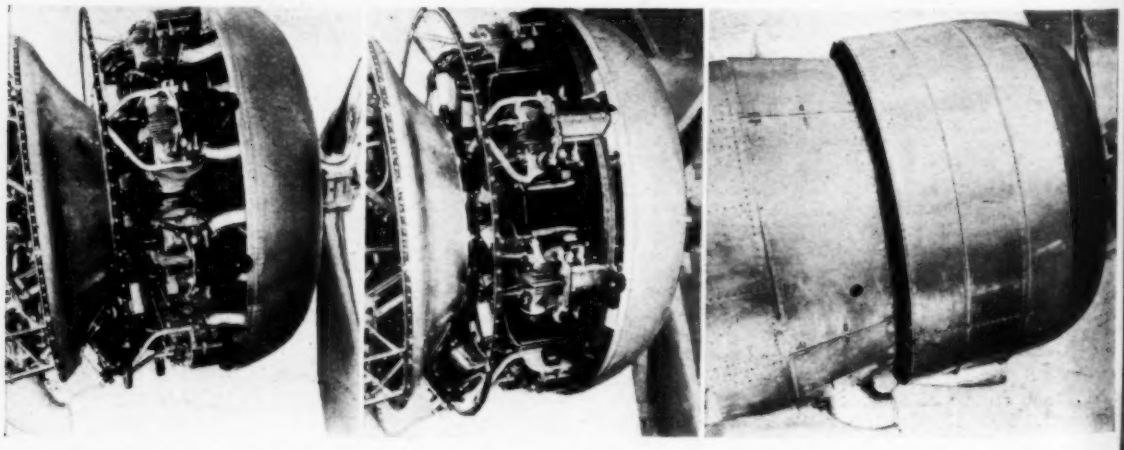
Although on the face of it this seems an amazingly simple arrangement, the whole cowling had to be designed with extreme caution in relation to a fuselage or nacelle behind it. The size and location of the annular opening for the return of the cooling air to the main stream also occasioned close study.

To this day there is a certain amount of scepticism among British constructors regarding the N.A.C.A. cowling. When first tried over here it was, in fact, by no means an unqualified success, mainly because of cooling troubles. The explanation of this lies in the comparatively steep climb of British machines made at a low forward speed and to the higher cylinder temperatures permitted in the U.S.A. Geared engines—particularly if supercharged, into the bargain—were the worst offenders, for there was comparatively little slipstream cooling from their big, slow-running airscrews.

But things are different to-day. It is due to the specially studied and baffled N.A.C.A. cowlings that the geared and supercharged engines on such successful machines as the Douglas, Boeing, Vultee and Northrop can operate within permissible temperature limits.

One recalls a particularly good illustration of this point. Just before the England-Australia race there were comments on the dangerously tight-fitting cowlings on some of the American entries. Colonel Fitzmaurice was forced to fly his Bellanca *Irish Swoop* to Mildenhall with no cowling over its fourteen-cylinder geared and supercharged Twin Wasp Junior engine. He announced, to the mystification of certain of the parochial-minded spectators, that he had been afraid that, without its cowling, his engine would overheat! They stood aghast.

That story raises another point. A great deal of trouble has been experienced with N.A.C.A. cowlings threatening to come adrift in the air due to the forward force they exert. While travelling at something like 300 m.p.h. an American racing pilot discovered that his cowling was slowly creeping forward into the airscrew! He managed to put his machine down before that pushful component



In these three views the main features of a modern baffled installation are readily seen. The first two show the specially shaped "shoulder" which conducts the cooling air out of the "gills"; in the second the inter-cylinder baffles are visible, and the third shows the complete installation. The nose portion forms the exhaust ring. Actually this installation is of one of the 690 h.p. Bristol Pegasus III's in a Douglas D.C.2.

The modern long-chord cowling is designed in relation to the body behind it. Note in this view of one of Sabena's Savoia Marchettis how the cowling of the fuselage engine increases in diameter toward the rear and how that of the outboard units taper in the opposite sense. (*Flight* photograph.)

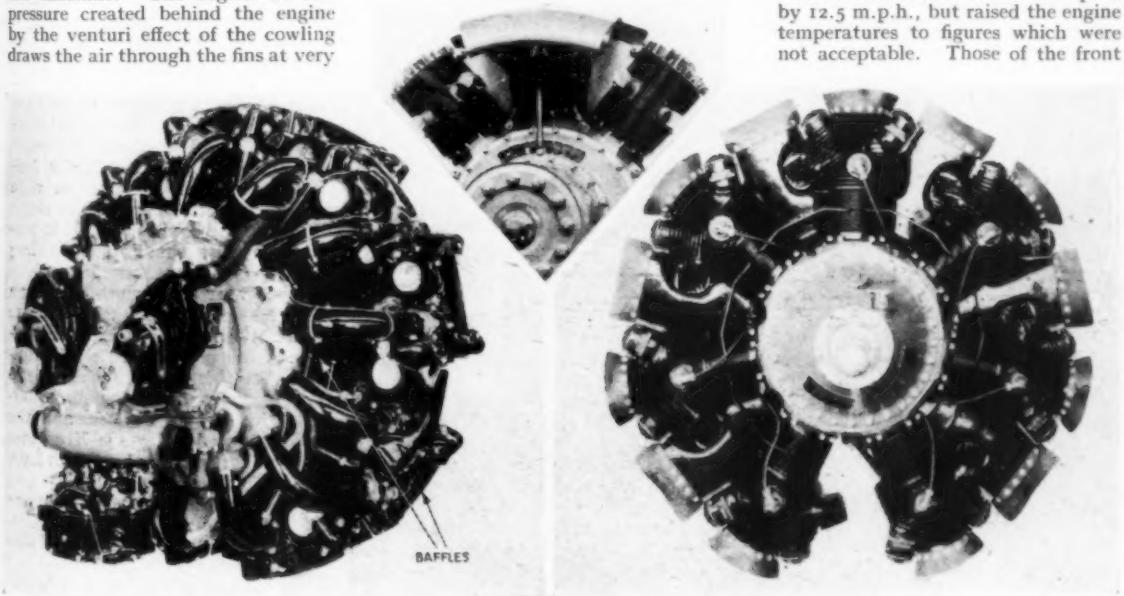
caused a spectacle not on the National Air Race placards.

And what are the secrets of the very latest cowlings? How can they add many m.p.h. to the speed of a machine and yet cool a 1,000 h.p. geared and supercharged fourteen-cylinder two-row engine, with the massive hub and shanks of a variable-pitch airscrew blanking off most of the slipstream?

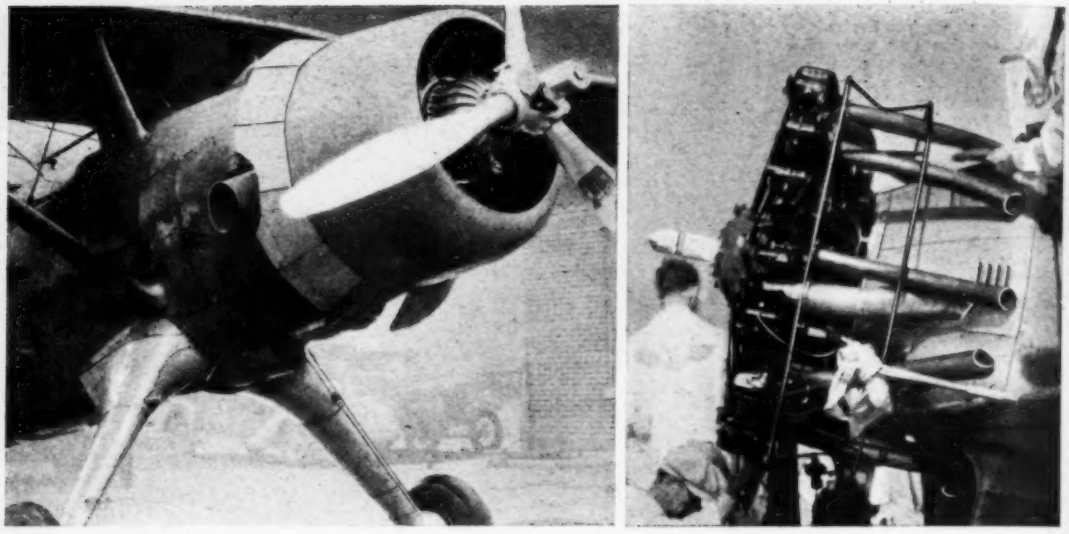
It is not possible, of course, to take just any radial engine, put in an N.A.C.A. cowling, fit it with baffles, and expect it to operate without overheating. The barrels and heads of the cylinders must have adequate fin area to cope with the high percentage of total power demanded continuously from the really modern closely cowled aero engines.

Baffles are provided to blank-off the free flow of air over the engine and to direct it so that the cylinders are cooled most effectively. These baffles on a normal single-row engine usually take the form, viewed from the front, of metal deflectors shaped to fit between, and to follow the contour of, the cylinders, and to extend partially round the rear of the cylinders in plan view. Appropriate spaces are left for the cooling air to escape out of the "gills" of the cowling: the space between the fins and the baffles is very small so that the air is forced to flow through the fins. Inter-rocker-box baffles are also in vogue, which means that the bulk of the air is built up in front of the engine by the airscrew and the forward speed of the machine. The region of low pressure created behind the engine by the venturi effect of the cowling draws the air through the fins at very high speed. Engines with a complete baffling system closing off all the space under the cowling (except that which admits air to the fins) are said to have "pressure" baffles.

Naturally enough, the baffling of a two-row engine is comparatively difficult. At first it was not easy to supply the rear bank of cylinders with air which had not been heated through contact with those in the front row. It was, in fact, test flying with the original Pratt and Whitney Twin Wasp fourteen-cylinder engine in a Vought Corsair which gave rise to a large amount of experimental work with baffles and cowling. When this combination was flown with no ring cowling the cooling was quite satisfactory. The addition of a ring of narrow chord increased the maximum speed by 12.5 m.p.h., but raised the engine temperatures to figures which were not acceptable. Those of the front



In the top view may be seen the simple baffling possible through the clean design of a sleeve-valve engine (a Perseus); the left-hand view indicates the baffling arrangements on a fourteen-cylinder two-row Twin Wasp; and the third view shows the very latest Wright Whirlwind with its baffles (note the flexible junction pieces).



"Controlled cooling" permits an adequate flow of cooling air under such exacting conditions as a sustained climb, but under cruising conditions gives a reduction in both air flow and drag. The left hand view shows the adjustable "skirt" on the N.A.C.A. cowling of a Douglas observation machine. (Twin Wasp Junior engine.) On the right can be seen what lay beneath the cowling of the Hornet engine of a Wedell-Williams racer a few years back.

heads, in fact, were increased by an average of 115 deg. Even with the removal of the large crank case cowl and the fairing between the front cylinders there was a negligible drop in the temperatures.

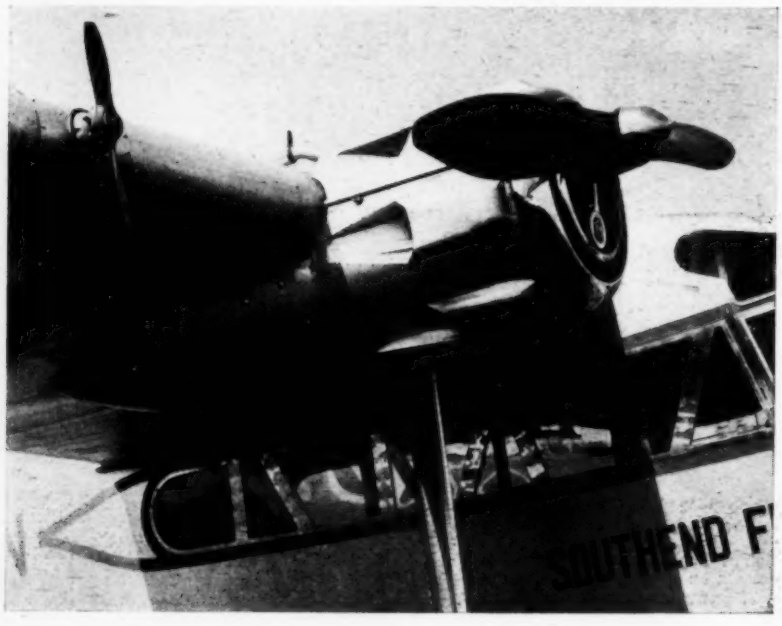
It was found that ordinary vee-type baffles of a type previously developed for single-row engines cooled the rear bank satisfactorily. Baffles of various designs were fitted to the front cylinders and inner flange cowls, similar to those seen at one time on our own A.W. XVI and Atlas II, were also tried, but left much to be desired. Then the pressure baffles were introduced, and showed that the experimenters had been barking up the wrong tree; they had tried to induce a large quantity of air to flow over the engine and to direct this to points which needed cooling, whereas future researches entailed the plugging of inter-cylinder and inter-rocker gaps to limit the air flow and to direct most efficiently what little air was admitted past the baffles.

The cowling now fitted as standard on the Armstrong Siddeley Panther and Tiger two-row radials comprises an inner and an outer ring. The inner one embraces the cylinder heads, and is devised to restrain the cooling air to flow through the cylinder finning. The outer ring is of deep section, and, apart from inducing a smooth external flow, encourages the passage of cooling air over the crank case and cylinders. Quickly detachable fittings secure the outer ring, which can be removed in a few minutes for the inspection and adjustment of the valve clearances. It is not necessary to remove the inner ring, which remains fixed, except when the engine is dismantled for overhaul.

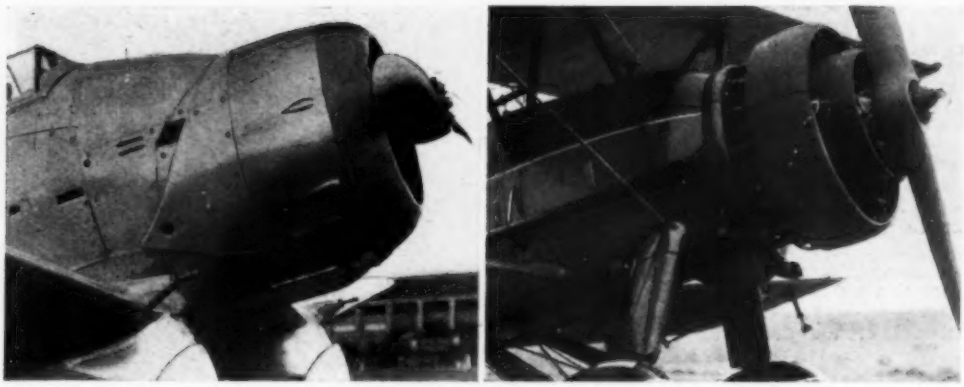
Interesting cowlings are not confined to high-powered engines. There is, for example, that developed for use with the Pobjoy types. Virtually, this is a combination of a long-chord ring cowling with individual cylinder helmets, which, in conjunction with deflector plates, control the circulation of the cooling air. It is possible to raise the Pobjoy cowling like the bonnet of a motor car.

A number of modern American civil and commercial machines are fitted with the new flapped cowling, which permits controlled cooling. In this country the Bristol Aeroplane Co. has been experimenting with similar devices, and the cowlings of the Pegasus X engines of the Short Empire boats will have adjustable skirts.

Briefly, these controlling systems provide adequate cooling for variations in air temperature, and give



The present Pobjoy cowling is of long chord and incorporates "helmets" for the cylinders. This installation is of a Niagara in a Short Scion. (*Flight* photograph.)



A somewhat unusual cowling was fitted to the Mercury engine of the Bristol 133 fighter. On the right is the A.W. XVI (Panther) of a few years ago ; it had an inner flange cowl in addition to its Townend ring. This arrangement is not now standard on the two-row Siddeleys. (*Flight* photographs.)

the minimum engine drag for a particular machine and engine operating condition. The volume of air required to cool an engine varies considerably with the speed of the machine in which it is fitted, which means that the cowling which functions quite satisfactorily at high speeds, may be deficient at climbing speeds, with resulting overheating of the engine. Experiments with adjustable noses for N.A.C.A. cowlings presented mechanical difficulties, but flaps placed round the trailing edge gave satisfaction. The position of these flaps can be controlled from the cockpit, and on a typical installation have a movement of about 30 deg.

Although the cowling and cooling of four- and six-cylinder-in-line engines appears perfectly straightforward (and, in practice, is so), this perfection has been attained only by arduous experiments.

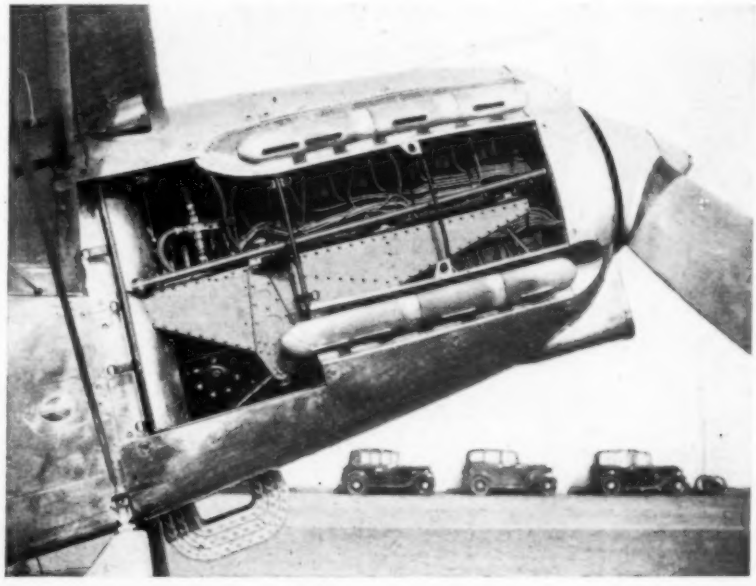
The De Havilland Gipsy Six and Major engines embody an air scoop on their port side, the engine being kept clear of obstruction in this region. From the inlet in the nose the air rushes down this scoop and is trapped by a plate at the rear. So it flows between the cylinders, and is caught by baffles on the starboard side, which conduct the leakage through gaps corresponding to the centre line of each cylinder barrel. Cylinder head baffles conduct air over the combustion chamber and exhaust ports, but it is not necessary to feed the inlet ports. The heated air is sucked from the main engine bay out of a slot formed by the cowling on the starboard side.

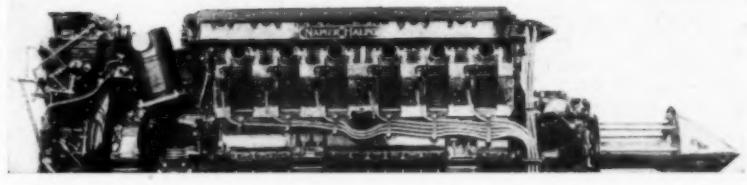
In some installations a small inlet can be seen alongside the main scoop. This is to admit air to the front cylinder. Yet a third hole may be provided to cool the exhaust manifold.

The latest Cirrus Hermes practice provides for a cooling chute, the rear half of which is open along its top section. The "screen" which holds the air in the chute to the cylinders is virtually a right-angled continuation of the side of the scoop. Baffling is provided all along the cylinder bank on the starboard side, from which viewpoint the cylinder barrels are completely hidden.

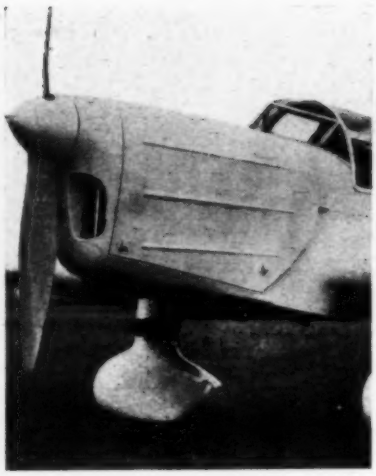
New problems naturally arose with the introduction of D. Napier and Son, Ltd., of their Rapier and Dagger "H" type air-cooled four-bank engines, but, as a result of very extensive experimental work, adequate cooling has been secured with very long drag.

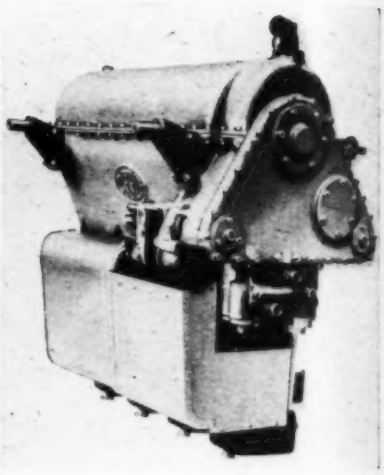
The Napier engines are cooled by an arrangement of air ducts, baffles, and exit louvres. The air flows into the entry duct, thence to pressure chambers formed by the upper and lower pairs of cylinder banks, and then, after passing between the cylinders and baffles, is discharged via the louvres to the outside of the engine cowling. A





The top picture shows one bank of a Napier Dagger 24-cylinder engine with its inter-cylinder deflectors. Note in the bottom view—a *Flight* photograph of a similar engine installed in a Hawker Hector—the position of the air scoops for top and bottom cylinder banks.





The in-line air-cooled engine permits a clean cowling installation, as typified on the Miles Hawcon (D. H. Gipsy Six) in the *Flight* photograph on the left. The right-hand view shows the arrangement of the air scoop on the new Cirrus Major.

spinner assists the air flow into the entry ducts.

The cowling in use a year or two ago was made with straight-sided entry ducts, and had an exit formed by an annular space, 50 per cent. larger than the area of the entry ducts, at the rear of the engine, forward of the fireproof bulkhead. It was flared at the exit to induce the air flow through the cylinders.

In order to reduce the drag, the cowling was redesigned and an exit louvre was arranged on each side of the fuselage. Air was conducted toward the exit by baffles, and each exit louvre was flared to assist extraction.

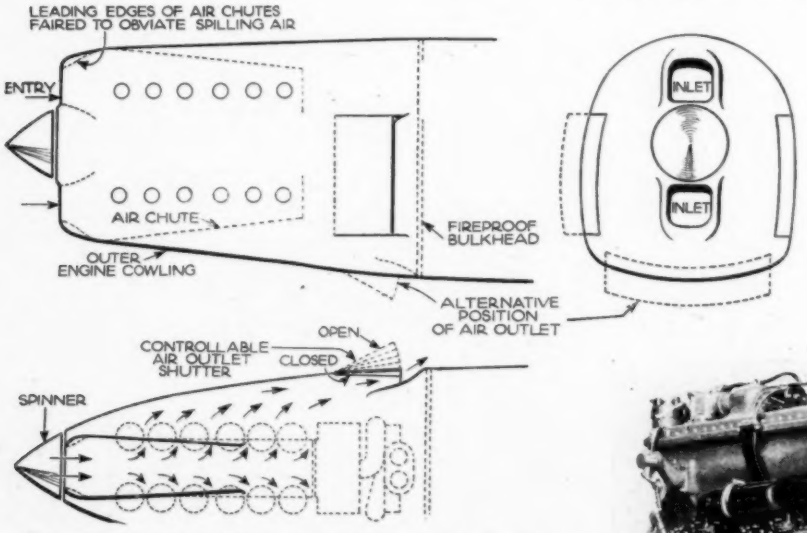
With both the aforementioned systems it was found that the drag due to cooling was still considerable, and experiments were conducted to reduce drag at the air entry chutes. It was discovered that if the entry ducts were faired internally and externally, the entry area of the ducts could be reduced by about 20 per cent. with a substantial drag reduction.

When it became desirable to control the amount of air passing over the cylinders during climb and level flight, a cowling using a shrouded exit flap, adjustable in flight, on each side of the engine nacelle in the same position as the earlier fixed louvres was constructed. Under climbing conditions these flaps could be opened if necessary to their maximum area of 55 per cent. greater than that of the entry ducts, and during high-speed level flight they could be closed to the minimum area of 5 per cent. greater than the ducts. This type of cowling has resulted in the reduction of the cooling drag of the "H" type engine to 1½-2 per cent. of the total engine power.

In practice, when this new cowling is fitted, its front portion and the entry ducts are combined. This combination is attached to, and carried on, the engine, independent of the main cowling. The outer cowling of the engine is mounted on supports carried on the engine mounting, and is not attached to the front nose cowling. Thus, the latter unit is enabled to move with the engine independently of the cowling proper, thereby eliminating the possibility of damage due to the movement of the engine in its flexible mounting.

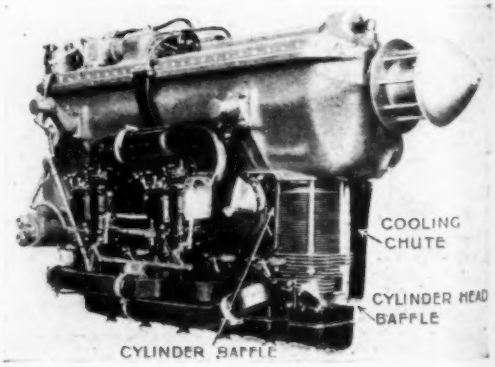
The references made in this and its companion article can give only a general idea of the immense amount of work which has been done to reduce drag and increase the efficiency of cooling systems. There is much yet to be done. It should not be long before we see air-cooled radials buried completely within the fuselage. Elaborate forced-draught systems may be necessitated; shaft drives will become necessary, but whatever the problem it will be tackled by the "air-cooled" protagonists with the same determination which has brought about the developments already described.

Already an American Autogiro has been designed with a Pobjoy engine housed in its fuselage.



Left: The latest cowling and cooling arrangements developed for the 24-cylinder Napier Dagger.

Below: Showing the location of the chute and baffles on the 200 h.p. D.H. Gipsy Six.



THE FOUR WINDS

ITEMS OF INTEREST FROM ALL QUARTERS

THE Duke of Kent has entered the Mew Gull for the King's Cup Race. Capt. Percival, as last year, will be the pilot.

During the first quarter of this year 115,800lb. of mail was carried by air from Britain.

The Goodyear Zeppelin Corporation plans to build an airship 75ft. longer than the *Hindenburg*.

Money for the building of the Zeppelin LZ131 has been secured. Work began some time ago on the LZ130.

Makhotkin and Vodopyanov, the Soviet airmen who left Moscow on March 29, have arrived in Franz Josef Land.

Northumberland County Council proposes to appoint for two years a Director of Air Raid Precautionary Measures at a salary of £1,000 a year.

Sixteen Berlin streets have been renamed after famous German airmen, including Richthofen and Immelmann.

Meanwhile, it is said, Eckener Allee has been unobtrusively changed to Zehlendorfer Damm as part of Dr. Goebbel's boycott of Dr. Eckener.

Mr. Robert Kronfeld is an experienced pilot of craft larger than sailplanes and Drones. Recently he took a Monospar S.T.25 out to Austria, where Prince Starhemberg tested its suitability for work in mountainous country.

MORE DRAGONS' TEETH: Austria's air force, forbidden under treaties, was inspected by Herr Schussnigg during the spring parade in Vienna. The machines seen here are Fiats of the improved C.R.20 type.

The Future of Brooklands

It was stated last week that, though Brooklands has been purchased by a syndicate (for a sum said to be in the neighbourhood of £200,000), it will retain its present status for at least five years.

Bring Out Your Poux!

The Air League of the British Empire appeals to all *Pou-du-Ciel* owners to put their machines—even if only partially finished—at the disposal of the nearest civil aerodrome for exhibition on Empire Air Day, May 23.

The "Hindenburg's" Schedule

Following her return from South America the Zeppelin *Hindenburg* will make trips from Frankfort to Lakehurst on May 6 and 17 and June 18 (arriving at Lakehurst on May 8, 19 and June 20), and in the reverse direction on May 11 and 20 and June 21, reaching Frankfort on May 14, May 23 and June 24.

Empire Air Day

An Air Ministry Order now deletes Bicester, Catfoss, North Weald, Upavon and Wittering from the list of R.A.F. stations to be open on Empire Air Day, published in *Flight* of March 26.

The Austin Factory

Plans for the new Austin aircraft factory at Longbridge, Birmingham, have been provisionally approved by Bromsgrove Council. The works, which will employ between 5,000 and 6,000 people, will cost some £300,000.

"Smithy's" Trophies

Lady Kingsford-Smith has offered to loan her late husband's flying trophies to the Australian Government for exhibition to the younger generation. They include dozens of gold and silver cups, a gold medal weighing half a pound, presented by Mr. Anthony Fokker, and a slab of greenstone bearing a golden map of Australia and New Zealand, apart from at least a score of gold cigarette cases and thirty fountain pens.

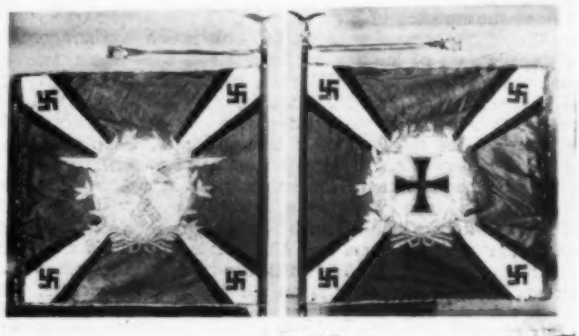
Twenty-five Years Ago

(From "Flight" of April 29, 1911.)

". . . the latest Breguet, showing how a Gnome rotary engine is used to drive a Breguet flexible propeller at reduced speed through gearing. The blades of the flexible propeller are hinged to the boss, and are anchored by springs arranged to allow the blades to fold back slightly under sudden load."

(Left) Capt. C. E. Lynch Blosse, Chief Constable of Leicestershire, who hopes shortly to take his "A" licence at Braunstone (Leicestershire Aero Club). His brother, Mr. P. W. Lynch Blosse, is technical adviser of British Airways, Ltd.

(Right) The new German Air Force flag.



Private Flying

Topics of the Day

Landing Fees

THIS depressing question of landing fees appears just now to be engaging the attention of a good many of the more energetically minded private owners. Some of them are endeavouring to work a form of boycott as an answer to what someone has very happily labelled "sanctions."

Unfortunately, boycott or no boycott, one does not fly merely to arrive anywhere, and sooner or later the most haphazard pilot is bound to alight on or in an aerodrome from whose control office the bailiffs will emerge, palm outstretched. It is not in the least curious that owners who spend upward of a couple of hundred pounds yearly on this flying business should grudge the odd eighteen pence, half-crown, or so. If the sum went to the wives of aged control officers nobody would mind, but these owners merely object to the idea on principle.

The clubs, the club pilots, and, in sequence, the private owners, who have done more than anyone to encourage flying in this country, spend quite a large amount of money at every aerodrome, and they feel that it is something of an insult that they are made, in addition, to pay a landing fee. A correspondent in this week's issue has put the matter in a nutshell when he says that "in the olden days one felt that one was a welcome visitor at every club, just as we welcomed others at clubs of which I happen to be a member."

The Other Side

FROM the aerodrome owners' point of view, of course, there is no reason at all why every pilot, whether he or she is carrying fare-paying passengers or not, should not pay a small sum for the upkeep of the green—though goodness knows that the few shillings taken daily from the private pilots will hardly help to pay the interest on the quarter-million or so which may have been spent on an aerodrome layout. The point is that unless *all* aerodrome owners agree to inflict such penalties, it simply will not pay them to do so.

Count the number of owners and club pilots who come into Croydon—where I paid 7s. 6d. only a few weeks ago for the pleasure of landing on its switchbacks—and then count those who come into Heston, where no landing fees are charged. The fact that one is, reasonably enough, charged there for everything else does not deter owners, and therein lies the kernel of the problem. People do not mind paying for services rendered, and an aerodrome owner who charges more for hangarage but nothing for landing will always get away with it.

One well-known club which has been charging fees found that so few owners and club pilots turned up that the charge has had to be washed out. At the other extreme is Lympne, which is an Air Ministry aerodrome. Landing fees are charged there, but people still roll up in fair quantities, partly because the reception is far from official and partly because the other expenses are trivial. Last week, for a sum of 1s. 6d., my hired machine was housed for the night, moved about and run up for me in the morning. As a country member of the club no landing fee was charged, and I am not sure what this would have been. (Moral: Become a country member of *every* club!)

Luggage Accommodation

A FEW weeks ago, when idly discussing the points of the single-seater, I suggested that the average pilot was a good deal more interested in luggage accommodation than was generally imagined. The days have gone when an amateur was satisfied to carry a pair of pyjamas and a tooth-brush on his trips, and the fact that one has come by air is now a poor excuse for rolling in to a club party encased in a set of oily plus fours and a sports shirt. One can, of course, wear overalls over a dress suit, but only the least self-conscious of persons would be happy in such garments during the following two days while waiting for winter to turn to summer and the clouds to rise from the visited aerodrome!

Mere *volume* of luggage accommodation is of little value if the shapes of the lockers are odd, and acreage is the only thing that really matters. Nobody cares to pack a much-admired suit in a haversack, or even into a miniature case, and a space of at least 2½ft. by 1½ft. by 1ft. is essential for the happy tourist—with as much more in height as can possibly be discovered by the worried designer of a private owner's aeroplane.

Space Before Volume

AMONGST the less expensive aeroplanes one must hand a prize to the Hornet Moth, in which there is space and to spare; with metal ribs and strong straps—which are there to be used.

Flying over Kent last week-end beneath a very low cloud base in a tapered Hornet, my case would most certainly have been launched into the dashboard, with fatal results, if it had not been firmly strapped in place. The bumps were exhilaratingly terrific, and, though I was held in by a thigh belt, my head hit one of the roof members on several occasions, and after I had looked down at my maps for a moment the machine was usually found on one wing tip or the other. As a passenger I should have hated it, but as the pilot these bumps took my mind off other matters.

Incidentally, every club should have a radio set in the member's room, so that they and the visiting pilots can listen to the half-hourly meteorological broadcasts which save so many shillings in last-minute telephone calls. Although these broadcasts do not cover every aerodrome of importance, they do cover every area, and are a great deal more comforting than the general forecasts for the whole country, however accurate these may sometimes be.

INDICATOR.

FROM the CLUBS

Events and Activity at the Clubs and Schools

YORKSHIRE

THE week ending April 17 contained a good deal of bad flying weather. Club machines flew 8 hr. 40 min. The following week, 33 hr. 20 min. flying was recorded. The new Hornet Moth, G-ADNE, has arrived and the joy-riding Scion, G-ACJI, is back from Rochester, where it has been undergoing its C. of A. overhaul. Mr. J. J. Lister has rejoined the Club.

LONDON

Last week's flying time was 68 hr. 15 min. Mr. N. A. Buchanan completed the night-flying test for his "B" licence and Messrs. G. Maxwell-Eves, J. Heriz-Smith, and J. W. Woolley became members.

LEEMING

The date of the official opening of York Municipal aerodrome has been fixed as July 4. The ceremony will be performed by Lord Swinton, Secretary of State for Air. Yorkshire Aviation Services have been appointed the main distributors for the Hillson Praga and hope to take delivery of their first machine in a few weeks' time.

PORTSMOUTH

A B.A. Swallow was demonstrated at Portsmouth two week-ends ago and a number of members tried it out. Lt. Cdr. R. L. Fisher, R.N., has gone solo and Lt. Nigel G. Hallett, R.N., F. Alford, J. C. Parkinson and Capt. R. D. Hog have become members. For the week ending April 24 the flying time was 25 hr. 25 min.

CAMBRIDGE

For the fortnight ending April 18 the flying returns of Marshall's Flying School, Ltd., showed 84 hr. Miss Cawood and Messrs. Cone and Brown went solo. Lord Pentland and Mr. Cone completed their "A" licence tests in face of unfavourable weather. It is expected that four new "A" licences will be obtained within the next few days.

KUALA LUMPUR

The annual report of the Kuala Lumpur Flying Club shows that there were five hon. members, 153 flying members, and 77 non-flying members at the end of 1935. The flying time for the year was 1,344 hr. This is considerably less than the total for the previous year, but the reconstruction of the aerodrome and weather conditions can be blamed.

SOUTH STAFFS

The Club is going ahead with its two machines. There are several private owners among the 100 members. Mr. Campbell Black visited Walsall aerodrome last Sunday on his way to Wolverhampton to join his circus, which, incidentally, visited Walsall last Saturday. Mr. Proffit has started his "A" licence tests. The annual general meeting was held on April 23. The well-balanced accounts were due in a great measure to the Vice-Chairman, Mr. Minors, the Hon. Treasurer, Mr. Langley, and the Hon. Secretary, Mr. Parkes.

NORFOLK AND NORWICH

There was no Club flying during the few days following the Easter holidays, but despite this members were able to get in about 30 hr. flying during the remaining few days. A number of visitors arrived by air for the Club's annual dinner. Of these Mrs. J. S. Crossley managed to leave Mr. C. W. A. Scott's Flying Display to receive the President's Trophy. Flt. Lt. T. Rose and Mrs. Rose arrived in a Hawk from Reading. A landing competition held two week-ends ago was won by Mr. N. Brett.

BORDER

Work on the aerodrome draining and levelling scheme has been suspended until the end of the year. The workmen are now all concentrated in preparing two additional fields for inclusion in the aerodrome proper. Dr. J. S. Thomb has joined as a flying member, Mr. R. S. A. Beauchamp has passed his cross-country test, and Mr. T. Hodgson his passenger-carrying test. British Airways resumed their Isle of Man and Belfast services on April 26. The aerodrome will be open to the public on Empire Air day (May 23).

LEICESTERSHIRE

The Club's generous President, Mr. Lindsay Everard, in appreciation of the Club's sound financial policy (largely instigated by the Hon. Treasurer, Mr. Teddy Underwood) has presented the Club with a Moth Major, completely fitted out with blind-flying and night-flying equipment. The Club's fleet has thus been raised to four machines. The Hon. Frances Tollemache having taken her licence in three weeks is setting out on a 30,000 mile trip in her new Vega Gull in company with Mr. Motion. Capt. Lynch-Blosse, the Club Chairman, has, it is claimed, become the first policeman in any county to take his "A" licence. Included in the number of old members who have returned to keep their licences in force are Mr. F. C. Furlong, of Grand National fame, and Mr. Bobby Lowenstein. Colonel Fanshawe has also renewed his "A."

PENANG

Membership increased from ninety-eight to 170 during 1935. The Club's five aircraft flew 1,872 hr.

WITNEY AND OXFORD

Having completed 100 hr. solo flying each Mr. H. A. Glogauer and Mr. R. J. B. Pearse are about to essay tests for the "B" licence. Flying time for the week ending April 25 was 26 hours.

CASTLE BROMWICH

Mr. P. R. Burton has passed his "A" licence tests and Miss S. Parish and Messrs. B. E. Feilding, G. Norton, and D. V. Bergin have become members. Flying times for the week ending April 24 were 18 hr. 45 min. dual and 14 hr. 45 min. solo.

BENGAL

The flying times for March were 26 hr. 35 min. dual and 47 hr. 50 min. solo. The Ruling Chief of Athgarth, in addition to going solo, has passed his "A" licence tests, purchased a Puss Moth, and constructed a landing ground in his State. Mr. B. G. Gadgill has also gone solo.

ROYAL AIR FORCE

Flt. Lt. S. C. O'Grady went abroad with the Club Puss Moth and was away between April 6 and 17. His original intention was to reach Tangier but the weather made it impossible for him to get any farther than Cannes. Air Marshal Sir J. M. Steele, K.C.B., K.B.E., C.M.G., F/O. W. F. Beckworth, Flt. Lt. E. M. Drummond, and F/O. H. J. Kirkpatrick have become members of the Club.

CINQUE PORTS

High winds and the general unkindness of the weather are responsible for Mr. C. Hilton-Simpson failing to get his licence before returning to Oxford. On Sunday, however, he went solo and put in some of the solo time necessary. Mr. George Seversky, who entertained so excellently at the dinner and dance, used a Club machine to fly himself to Heston and back, while his pianist, Mr. Launitz, a pilot of considerable experience but rather out of practice, took some dual. The four new members last week were Mrs. M. K. Wilberforce, Mr. J. H. Johnson, Mr. A. E. Jolivet, and Mr. J. B. Garland. Five Club aircraft took part in the Dawn Patrol organised by Brooklands and the South Coast Flying Club. Mr. Leslie Cliff in the Leopard with Mrs. Cliff got through without having their registration letters observed and thereby earned for themselves a free breakfast.

LORD LONDONDERRY, during his tenure of office as Air Minister, was a keen pupil and private owner. He retains his interest and is seen above about to try a D.H. Hornet Moth at Hatfield in company with Mr. Peter de Havilland. The machine is actually the London Aeroplane Club's latest latest acquisition, and not "ADIS." (*Flight* photograph.)

Private Flying

C.A.S.C.

Three machines flew to Hatfield last week-end and four new members made their first flights. The flying times were 3 hr. dual and 4 hr. 30 min. solo.

REDHILL

For the week ended April 24 flying time was 74 hr. 5 min. Cross-country flights included trips to Rotterdam and Barnstaple. Mr. P. Eves completed his "B" licence tests and six new members joined the Club.

SOUTH COAST

A successful "eve of the battle" dinner-dance was held on Saturday. The following morning there was a mighty "Dawn Patrol." Fifty-eight machines attacked the aerodrome, which was defended with ten aircraft. Over 130 people sat down to breakfast, some of them having come from so far away as Leicester and Bristol. New members include Messrs. Nield, Baldwin and Benn.

BROOKLANDS

Flying times during the beginning of last week were none too good owing to weather, but on Thursday about 20 hours were recorded, in addition to three long charter trips, one to the Shakespeare Centenary celebrations at Stratford-on-Avon, and two others to Wales. New members are: Messrs. Marwick, Beer, and Dence. Mr. Sumner has completed his "A" licence tests, and the Hon. Ruth Cockayne has essayed her first solo flight. Lord Beaverbrook and party visited Brooklands on Saturday for trial spins in a new Dragonfly piloted by Mr. Buckingham. The Hon. Drogo Montagu landed in his "Vega" Gull and joined Lord Beaverbrook's party. Eight machines from Brooklands flew down to Shoreham on Saturday night and enjoyed a dinner and dance at the South Coast Flying Club preparatory to lending them a hand to defend Shoreham on the morning's "Dawn Patrol." Another eight machines flew down on Sunday morning and took part in the attack which was made by about sixty machines.

HERTS AND ESSEX

In the competition for the "55 Squadron" challenge cup, Mr. W. Mason retained the trophy for the second year. Messrs. Pyle and Gay were second and third respectively. A cross-country competition has been arranged for the "Cads" tankard. This event will be open to pilots with under 20 hr. solo experience, a "safety" pilot being carried in each case. Club machines flew 141 hr. 21 min. during the fortnight ending April 23, and Messrs. G. H. Hadland, E. A. J. Koch, M. V. Laurie and C. H. Blaker became members.

BRISTOL AND WESSEX

On Sunday, April 26, three Club aircraft and Mrs. P. V. Wills in her Hornet Moth went to Shoreham on the "Dawn Patrol." Mrs. Wills was the only visitor from Bristol to obtain a free breakfast. So many machines, however, were arriving that it was impossible to tell "friend from foe" and breakfasts, after all, had to be paid for. A visitor to the Club last week end was Mrs. Roberts, who has recently returned from Kenya. Mrs. Roberts will probably be better remembered by her maiden name of Crilly. Flying time last week was 26 hr. 20 min.

HANWORTH

Flying times last week totalled 28 hours 45 minutes. High winds and low cloud prevailed. New members were: Messrs. O. Moore (National League of Airmen) and B. Buchegger, who is being trained for his "B" licence. Mr. P. Veale (National League of Airmen) went solo, G. Valentine and H. M. Laurie passed their "A" licence tests, and C. Pountney and F. Hayes renewed their "As." An enjoyable time was spent by a number of Hanworth members who took part in "raiding" Shoreham in connection with the "Dawn Patrol." The crews of the Club's Monospar and of one of the Moths were successful in feeding at the expense of Shoreham Club. A similar "Dawn Patrol" will be held at Hanworth on May 10. Particulars have already been forwarded to secretaries of all clubs within a reasonable distance. A Treasure Hunt Party will be held at the Hanworth Country Club on May 1.

The Praga Engine

FOR some time various interested people have been wondering which firm would have the work of building the engines for the Praga monoplane which is, of course, being made in this country by F. Hills and Sons.

It now transpires that these engines, designed by the Praga Company, will be made by Jowett Cars, Ltd., of Idle, Bradford. This firm has had a very considerable experience of transverse-twin engines which have been used in Jowett cars for something like twenty-five years. The order is for quite a large number.

Flying and Fly-fishing

ON May 18 the Bernay Flying Club (Normandy) is organising a "trout-fishing air rally" and every arrival will, on leaving, receive a number of trout quite apart from those which he or she has been lucky enough to deal with.

The Bernay landing ground lies 2 km. to the west of the town and has runs of more than 500 yards. Bernay itself is situated on the Charentonne River and is well-known as a trout-fishing centre. Entry fees (30s.) can be received until May 19 at the Club Aéronautique de l'Arrondissement de Bernay, Bernay Eure, Normandy.

Informality at Folkestone

A FLYING time total of something like 2,000 hours in a year is certainly one to be proud of, particularly if this total shows an increase of 600 hours on that of a previous year, but more important and more interesting are the number of "A" licence renewals and the number of hours put on yearly by each of these licencees. So often do novices obtain their licences and just fade away. At the Cinque Ports Club they do *not* fade away.

During a short speech at the club's annual dinner and dance held at the Grand Hotel, Folkestone, Mr. W. E. Davis, the managing director, explained that there had been fifty-three renewals and that each of the pilots concerned had put in nineteen hours' flying. Before proposing the toast of the guests he read a few telegrams from "non-starters" such as Mr Van Marken, who had gone to South America, and Capt. Duncan Davis, of the Associated Brooklands Club, who spoke of "scrambled aspirins" for the breakfasts of those who had attended the party Mr. Charles Hall, who is chairman of the Folkestone Chamber of Commerce, replied for the visitors in a few happy sentences.

Among the guests, such as Miss Jeanne de Casalis and Mr. Ken Waller, was Mr. Georges Seversky, who was brought specially over from Paris by Mr. Cliff in the club's Leopard, and who entertained the party in due course and with more than his usual ability Few people realise that this famous singer is the brother of the American designer and pilot of that name. Capt. E. W. Percival took the chair, but, like a wise man, said nothing. Although some 140 people sat down to dine there must have been more than 200 on the ballroom floor. Some of them even managed to put in an appearance at Lympne on the following morning.

The Bristol Party

ON last Friday evening the Bristol and Wessex Club's annual Aviation Ball was held at the Grand Spa Hotel, Clifton. Over 250 members and their guests attended, and although this was not a record, the evening was most successful—bar extension or no. Members' thanks are due to the Ladies' Committee, consisting of Mrs. Herbert Thomas, Mrs. Egbert Cadbury, Mrs. R. Ashley Hall, Mrs. Cyril Uwins, Mrs. Drew Smythe, and Mrs. John Tratman, for organising this event. The dance was followed by supper in the hotel grill room and, it may be imagined, by numerous private parties. Mr. Jerry Hoey and his Piccadilly Grill Band once again provided the music, and it is hoped that Mr. Hoey will look upon this trip as an annual event.

Poux at Speed

WHAT promises to be by far the most successful *Pou-du-Ciel* event yet held will take place on Bank Holiday Monday, August 3, when an international challenge trophy race will be held at the new Ramsgate Airport under the competition rules of the Royal Aero Club and the regulations of the F.A.I. There is a first prize of £100 and the trophy; a second prize of £60 and a trophy; a third prize of £40 and a trophy; and a fourth and fifth prize of £25 and £15 respectively.

The event is, of course, confined to the *Pou-du-Ciel* type of aircraft, and dimensions are specified in the regulations.

One very important proviso is that each pilot must have had at least 20 hours' flying experience of this type of machine, so the majority of English enthusiasts, at least, will have to put in some hard work to be ready in time. The fact that the event is being held so near the Channel Ports should ensure plenty of support from the Continent, and it is to be presumed that M Henri Mignet himself will be found among the competing pilots.

The number of laps to the six-mile circuit will be announced later, but intending competitors are assured that no machine will need to cover a greater distance than 65 miles non-stop.

The entry fee for each machine is £3 10s., which sum must be paid to Ramsgate Airport, Ltd., Brettenham House, Strand, W.C.2, not later than 6 p.m. on Monday, June 15. Entry forms are obtainable from the same source.

It will be recalled that Ramsgate Airport is one of the chain of airports now being operated by Mr. Whitney Straight.

April 30, 1936 Supplement to FLIGHT 462a

The AIRCRAFT ENGINEER

"FLIGHT" ENGINEERING SECTION

No. 123 (Volume XII No. 4) 11th Year April 30, 1936

MEAN AERODYNAMIC CENTRE and CHORD

Analytical Formulae for the Co-ordinates of the Mean Aerodynamic Centre of a Wing and for the Length of the Mean Aerodynamic Chord

By J. R. CREAN, B.Sc.(Eng.)

THE object of this paper is to deduce three simple analytical formulae giving the co-ordinates of the Mean Aerodynamic Centre (M.A.C.) and the length of the Mean Aerodynamic Chord in the case of a wing plan form whose inner portion is rectangular and outer trapezoidal—this being the most important contemporary type and including the simple trapezoidal plan form as a special case. The position of the M.A.C. of a wing and the length of the M.A. Chord are important in the determination of the balancing loads of an aeroplane, also as a means of comparing the relative C.G. positions for aircraft of varying wing plan form.

The M.A.C. is defined as that point on a wing about which—for constant dynamic pressure—the moment of the resultant air force is approximately constant at all angles of attack, and its location is defined by the co-ordinates :

$$\overline{Y} = \frac{\int_0^s K_N c\, y\, dy}{\int_0^s K_N c\, dy} \quad ; \quad \overline{X} = \frac{\int_0^s K_N c\, X\, dy}{\int_0^s K_N c\, dy} \qquad \ldots\ \ldots\ \ldots\ \ldots\ (1)$$

Where

s = semi-span.
K_N = normal force coefficient at a section.
c = the corresponding chord.
y = perpendicular distance of a section outboard from the wing root.
X = ordinate of locus of the aerodynamic centre of the individual chords measured from the datum shown in Fig. 1.

Having regard to the usual convention of expressing pitching moments of an aerofoil in terms of the chord length, the Mean Aerodynamic Chord may be defined as the linear parameter entering the expression for the magnitude of the moment of the resultant force.

If, as will be assumed to be the case in the deduction of the corresponding formula, the moment coefficient about the aerodynamic centre of each individual chord is constant over the semi-span, then the length of the Mean Aerodynamic Chord is given by :

$$\overline{C} = \frac{\int_0^s c^2\, dy}{\int_0^s c\, .\, dy} \qquad \ldots\ \ldots\ \ldots\ \ldots\ \ldots\ (2)$$

These three fundamental expressions may then be evaluated graphically for any plan form as described in Aeronautics Bulletin No. 26, 1934 (U.S. Dept. of Commerce) Paragraph 9, pages 14-16, from which publication the substance of the foregoing information has been extracted. This is, however, a somewhat cumbrous process, whilst on the other hand the formulae proposed enable the problem to be solved far more rapidly and directly in the case of the important class of plan form under discussion.

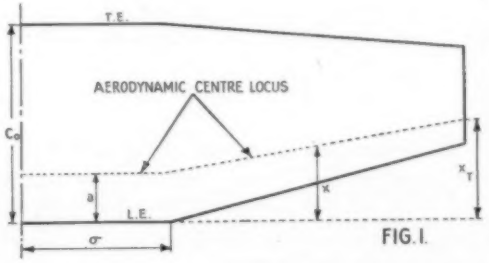


FIG. I.

In the deduction of the formulae for the co-ordinates of the Mean Aerodynamic Centre, the basic assumption will be made that K_N is replaceable by K_L — this being a very close approximation for all normal angles of attack. The lift loading, $K_L c/c_0$, (c_0 = root chord) over the semi-

span will then be taken in the form of a Fourier Series of the usual type, viz.:

$$A_1 \sin\theta + A_3 \sin 3\theta + \ldots A_{2n-1} \sin(2n-1)\theta + \ldots \quad (3)$$

the coefficients A_{2n-1} being evaluated by such frequently employed methods as those of Glauert or Lotz.

The semi-span will be considered to be of unit length.

(i) *Lateral Co-ordinate ($\overline{Y}$) of M.A.C.*

The fundamental formula, on replacing K_N by K_L, may be written:

$$\overline{Y} = \frac{\int_0^1 K_L\, c/c_0\, y\, dy}{\int_0^1 K_L\, c/c_0\, dy} \quad \ldots\ (4)$$

Substitute the series (3) in numerator and denominator, at the same time altering the independent variable to θ, where $y = -\cos\theta$. Hence as y varies from 0 to 1 over the positive semi-span, θ will vary from $\pi/2$ to π.

$$\int_0^1 K_L\, c/c_0\, y\, dy = -1/2 \int_{\pi/2}^{\pi} \sum_{n=1}^{n} A_{2n-1} \sin(2n-1)\theta \cdot \sin 2\theta\, d\theta$$

$$= 1/4 \sum_{n=1}^{n} A_{2n-1} \left(\frac{\sin(2n-3)\pi/2}{(2n-3)} - \frac{\sin(2n+1)\pi/2}{(2n+1)} \right) \quad \ldots\ (5)$$

Also:

$$\int_0^1 K_L\, c/c_0\, dy = \int_{\pi/2}^{\pi} \sum_{n=1}^{n} A_{2n-1} \sin(2n-1)\theta \cdot \sin\theta\, d\theta$$

$$= \frac{\pi A_1}{4} \quad \ldots\ (6)$$

Hence:

$$\overline{Y} = \frac{\sum_{n=1}^{n} A_{2n-1} \left(\frac{\sin(2n-3)\pi/2}{(2n-3)} - \frac{\sin(2n+1)\pi/2}{(2n+1)} \right)}{\pi A_1}$$

$$= \frac{4}{\pi} \sum_{n=1}^{n} \frac{(-1)^n}{(2n-3)\cdot(2n+1)} \cdot \frac{A_{2n-1}}{A_1} \quad \ldots\ (7)$$

This result is true for a wing of any plan form.

Since in practice it is customary to employ only four terms of the series (3), under this condition we have

$$\overline{Y} = \frac{4}{\pi}\left[1/3 + \frac{1}{5}\frac{A_3}{A_1} - \frac{1}{21}\frac{A_5}{A_1} + \frac{1}{45}\frac{A_7}{A_1} \right] \quad \ldots\ (8)$$

Note: For an elliptical load distribution, the coefficients A_3, A_5, A_7, etc., are each zero and we have the result:

$$\overline{Y} = \frac{4}{3\pi} = .425 \quad \ldots\ (9)$$

(ii) *Longitudinal Co-ordinate ($\overline{X}$) of M.A.C.*

The locus of the aerodynamic centres of the individual chords is indicated in Fig. 1. This locus will be assumed to intersect each chord at a constant fraction of its length. (The theoretical value* of this fraction is one-quarter, measured from the leading edge.)

Thus over the rectangular portion, σ, of the plan form, the locus will lie at a constant distance "a" from the leading edge, and over the trapezoidal will be given by the linear equation:

$$X = \frac{X_T - a}{1-\sigma} \cdot y + \frac{a - X_T\sigma}{1-\sigma}$$

where:

X_T = ordinate of the locus at the wing tip.

σ = length of parallel centre section.

The fundamental formula then becomes:

$$\overline{X} = \frac{a\int_0^{\sigma} K_L\, c/c_0\, dy + \frac{X_T - a}{1-\sigma}\int_{\sigma}^{1} K_L\, c/c_0\, y\, dy + \frac{a - X_T\sigma}{1-\sigma}\int_{\sigma}^{1} K_L\, c/c_0\, dy}{\int_0^1 K_L\, c/c_0\, dy} \quad \ldots\ (10)$$

Substitute, as before, the series (3) and let $\theta = \theta_0$ for $y = \sigma$. Evaluating each of the integrals in (10), in turn, we have:

$$\int_0^{\sigma} K_L\, c/c_0\, dy = \int_{\pi/2}^{\theta_0} \sum_{n=1}^{n} A_{2n-1} \sin(2n-1)\theta \cdot \sin\theta \cdot d\theta$$

$$= \frac{A_1}{2}\left(\theta_0 - \pi/2 - \frac{\sin 2\theta_0}{2} \right) + 1/4 \sum_{n=2}^{n} A_{2n-1} \left(\frac{\sin 2(n-1)\theta_0}{(n-1)} - \frac{\sin 2n\theta_0}{n} \right) \quad \ldots\ (11)$$

$$\int_{\sigma}^{1} K_L\, c/c_0\, dy = \int_{\theta_0}^{\pi} \sum_{n=1}^{n} A_{2n-1} \sin(2n-1)\theta \cdot \sin\theta \cdot d\theta$$

$$= \frac{A_1}{2}\left(\pi - \theta_0 + \frac{\sin 2\theta_0}{2} \right) - 1/4 \sum_{n=2}^{n} A_{2n-1} \left(\frac{\sin 2(n-1)\theta_0}{(n-1)} - \frac{\sin 2n\theta_0}{n} \right) \quad \ldots\ (12)$$

$$\int_0^1 K_L\, c/c_0\, dy = \frac{\pi A_1}{4} \text{ by (6)} \quad \ldots\ (13)$$

$$\int_{\sigma}^{1} K_L\, c/c_0\, y\, dy = -1/2 \int_{\theta_0}^{\pi} \sum_{n=1}^{n} A_{2n-1} \cdot \sin(2n-1)\theta \cdot \sin 2\theta \cdot d\theta$$

$$= 1/4 \sum_{n=1}^{n} A_{2n-1} \left(\frac{\sin(2n-3)\theta_0}{(2n-3)} - \frac{\sin(2n+1)\theta_0}{(2n+1)} \right) \quad \ldots\ (14)$$

Substituting for (11), (12), (13) and (14) in (10) we then get:

$$\overline{X} = \frac{1}{\frac{\pi A_1}{4}}\left[a\left\{ \frac{A_1}{2}\left(\theta_0 - \pi/2 - \frac{\sin 2\theta_0}{2} \right) + 1/4 \sum_{n=2}^{n} A_{2n-1} \left(\frac{\sin 2(n-1)\theta_0}{(n-1)} - \frac{\sin 2n\theta_0}{n} \right) \right\} \right.$$

$$+ \frac{X_T - a}{1+\cos\theta_0}\left\{ 1/4 \sum_{n=1}^{n} A_{2n-1} \left(\frac{\sin(2n-3)\theta_0}{(2n-3)} - \frac{\sin(2n+1)\theta_0}{(2n+1)} \right) \right\}$$

$$\left. + \frac{a + X_T\cos\theta_0}{1+\cos\theta_0}\left\{ \frac{A_1}{2}\left(\pi - \theta_0 + \frac{\sin 2\theta_0}{2} \right) - 1/4 \sum_{n=2}^{n} A_{2n-1} \left(\frac{\sin 2(n-1)\theta_0}{(n-1)} - \frac{\sin 2n\theta_0}{n} \right) \right\} \right] \quad \ldots\ (15)$$

which eventually reduces to the form:

$$\overline{X} = Aa + (1-A)X_T + \left(a - X_T\right)\left(a_1 + \sum_{n=2}^{n} a_n \cdot \frac{A_{2n-1}}{A_1} \right) \quad \ldots\ (16)$$

where:

$$A = \frac{\pi + (2\theta_0 - \pi - \sin 2\theta_0)\cos\theta_0}{\pi(1+\cos\theta_0)}$$

* By a theorem of N. E. Joukovski. In practice too this is the value employed.

$$a_1 = \frac{-\sin\theta_0 + \frac{\sin 3\theta_0}{3}}{\pi(1+\cos\theta_0)}$$

$$a_n = \frac{\left(\frac{\sin 2(n-1)\theta_0}{(n-1)} - \frac{\sin 2n\theta_0}{n}\right)\cos\theta_0 - \frac{\sin(2n-3)\theta_0}{(2n-3)}}{\pi(1+\cos\theta_0)} + \frac{\sin(2n+1)\theta_0}{(2n+1)} \quad .. \quad .. \quad .. \quad .. \quad (17)$$

The point to be noted here is that the coefficients A, a_1, a_2 are functions of θ_0 only, i.e., their magnitude is dependent solely on the amount of semi-span over which the wing is rectangular in plan form. Hence their values may be tabulated for various fractions of the semi-span as shown below.

Again, since in practice only four terms of the series (3) are employed, (16) becomes :

$$\bar{X} = A_3 + (1-A)X_T + (a - X_T)\left(a_1 + a_2\frac{A_3}{A_1} + a_3\frac{A_5}{A_1} + a_4\frac{A_7}{A_1}\right) \quad .. \quad .. \quad .. \quad .. \quad .. \quad (18)$$

which may be taken as the final form of the formula for $\bar{X}$ and is quite general for the type of wing plan form discussed. To facilitate the computation of the numerical values of the coefficients a_1, a_n the latter may conveniently be reduced to the following forms :

$$a_1 = -\frac{4}{3\pi}(1+\sigma).(1-\sigma^2)^{\frac{3}{2}} \; ; \; a_2 = -\frac{4}{5\pi}(1+\sigma).(1-\sigma^2)^{\frac{3}{2}}$$

$$a_3 = \frac{4}{21\pi}(1-8\sigma^2).(1+\sigma).(1-\sigma^2)^{\frac{3}{2}}$$

$$a_4 = -\frac{4}{45\pi}.(1-20\sigma^2+40\sigma^4).(1+\sigma).(1-\sigma^2)^{\frac{3}{2}} \quad .. \quad .. \quad .. \quad .. \quad (19)$$

since $\sigma = -\cos\theta_0$.

NUMERICAL VALUES OF THE COEFFICIENTS

σ	A	a_1	a_2	a_3	a_4
0*	1	−.4245	−.2548	.0006	−.0283
.05	1.0492	−.4452	−.2663	.0621	−.0281
.10	1.0972	−.4644	−.2759	.0604	−.0246
.15	1.1428	−.4824	−.2829	.0552	−.0179
.20	1.1872	−.4988	−.2874	.0465	−.0084
.25	1.2280	−.5132	−.2889	.0344	.0031
.30	1.2668	−.5260	−.2873	.0191	.0151
.35	1.3032	−.5368	−.2828	.0013	.0270
.40	1.3360	−.5444	−.2744	−.0183	.0358
.45	1.3664	−.5496	−.2630	−.0388	.0412
.50	1.3916	−.5512	−.2480	−.0591	.0413
.55	1.4116	−.5496	−.2299	−.0778	.0355
.60	1.4272	−.5432	−.2086	−.0934	.0235
.65	1.4368	−.5324	−.1845	−.1045	.0064
.70	1.4388	−.5152	−.1577	−.1096	−.0141
.75	1.4332	−.4916	−.1290	−.1075	−.0345
.80	1.4164	−.4584	−.0990	−.0972	−.0504
.85	1.3880	−.4136	−.0689	−.0784	−.0569
.90	1.3368	−.3518	−.0401	−.0523	−.0492
.95	1.2532	−.2586	−.0151	−.0224	−.0201

* Simple tapered wing. With the hypothesis made concerning the locus of aerodynamic centres, the M.A.C. of such a wing is easily verified to lie on that locus—a fact not necessarily true for other plan forms.

Here :

$$A = 1 \; ; \quad a_1 = \frac{-4}{3\pi} \; ; \; a_2 = \frac{-4}{5\pi} \; ; \; a_3 = \frac{4}{21\pi} \; ; \; a_4 = \frac{-4}{45\pi}$$

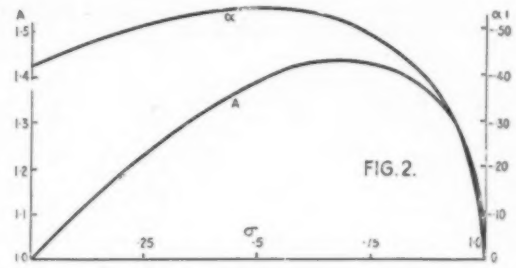
(on putting $\sigma = 0$ in(19)).

Hence :

$$\bar{X} = a + (a - X_T)\frac{4}{\pi}.\left(1/3 + 1/5\frac{A_3}{A_1} - \frac{1}{21}\frac{A_5}{A_1} + \frac{1}{45}\frac{A_7}{A_1}\right)$$

$$= a + (X_T - a)\bar{Y}$$

The coefficients for intermediate values of σ may be obtained by plotting those in the Table with σ as base. (Figs. 2 and 3.)

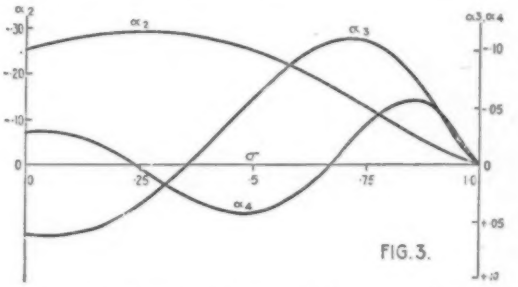


Note 1 : For $\sigma = 1$ (i.e. $\theta_0 = \pi$), which yields an entirely rectangular plan form, A momentarily assumes the indeterminate form o/o ; however, on evaluating by l'Hospital's Rule it will be found to have the value 1 ; moreover, for such a plan form $X_T = a$, and the terms $a_1 \ldots a_4$ are zero by (19). Under these circumstances (18) reduces to :

$$\bar{X} = a$$

which, of course, should be the case.

Note 2 : Although the taper ratio of the plan form $\left(\frac{\text{tip chord}}{\text{root chord}}\right)$ does not appear explicitly in the above formulae, its effect is taken into account by the coefficients A_{2n-1} of the Fourier Series (3) for the lift loading.



Note 3 : In all the preceding, it is assumed that the wing is untwisted ; a twisted wing has no M.A.C. because the shape of the loading curve is different for each angle of attack, and consequently there is no single point about which the moment of the resultant force will remain constant at all angles of attack.

Approximate Formula for $\bar{X}$.

In (18) the sum of the terms $\frac{a_2A_3}{A_1}$, $\frac{a_3A_5}{A_1}$, $\frac{a_4A_7}{A_1}$ is very frequently negligible in comparison with a_1 (see numerical example below for a wing of typical proportions) ; a good approximate form of the formula is then obtained by writing :

$$\bar{X} = Aa + (1-A)X_T + (a - X_T)a_1$$

$$= a(A + a_1) + (1 - A + a_1)X_T \quad .. \quad .. \quad (20)$$

all the terms of which are independent of the form of the lift loading curve ; in other words, $\bar{X}$ may be calculated immediately from the knowledge of the two geometrical parameters σ and X_T. As most contemporary wing plan forms yield loading curves that approximate very closely to the elliptical type, the form (20) is very convenient.

(iii) *Length of Mean Aerodynamic Chord* $\bar{C}$.

The fundamental formula (2) may be written :

$$\bar{C} = \frac{\int_0^1 (c/c_0)^2\,dy}{\int_0^1} \cdot c_0 \quad .. \quad .. \quad .. \quad .. \quad (21)$$

Over the range o to σ, $c/c_0 = 1$; from σ to 1 the variation of c/c_0 with y is given by the equation:

$$c/c_0 = \frac{\lambda - 1}{1 - \sigma} y + \frac{1 - \lambda\sigma}{1 - \sigma} \quad .. \quad .. \quad .. \quad .. \quad (22)$$

where λ = value of c/c_0 at the wing tip, i.e., the taper ratio.

Substituting for (c/c_0) in (21), we have:

$$\bar{C} = \frac{\int_0^\sigma 1^2\,dy + \int_\sigma^1 \left\{\frac{\lambda - 1}{1 - \sigma} \cdot y + \frac{1 - \lambda\sigma}{1 - \sigma}\right\}^2 dy}{\int_0^\sigma 1 \cdot dy + \int_\sigma^1 \left\{\frac{\lambda - 1}{1 - \sigma} \cdot y + \frac{1 - \lambda\sigma}{\sigma}\right\} dy} \cdot c_0$$

.. .. .. (23)

which finally reduces to:

$$\bar{C} = \tfrac{2}{3} \cdot \frac{(\lambda^2 + \lambda + 1) - \sigma(\lambda^2 + \lambda - 2)}{(\lambda + 1) - \sigma(\lambda - 1)} \cdot c_0 \quad .. \quad (24)$$

For a simple tapered wing $\sigma = 0$, and (24) becomes:

$$\frac{2}{3} \cdot \frac{\lambda^2 + \lambda + 1}{\lambda + 1} c_0 \quad .. \quad .. \quad .. \quad .. \quad .. \quad (25)$$

Numerical Example:

For the above plan form the data:

$\frac{A_3}{A_1} = .01166$; $\frac{A_5}{A_1} = .0171$; $\frac{A_7}{A_1} = .0205$

were obtained in the course of a span loading calculation, employing the Lotz method.

The locus of the aerodynamic centres of the individual chords was taken to intersect each at a quarter of the chord length, measured from the leading edge, i.e. the theoretical value.

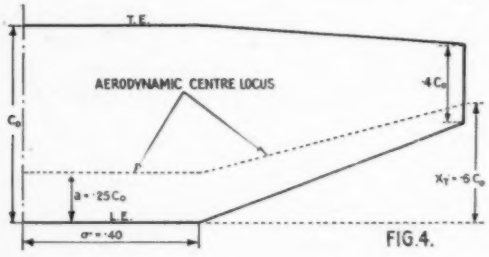


FIG. 4.

In the Fig. we have:

$a = .25\,c_0$; $\sigma = .40$; $X_T = .60\,c_0$

Then from the Table for this value of σ:

$A = 1.3360$; $a_1 = -.5444$; $a_2 = -.2744$; $a_3 = -.0183$; $a_4 = .0358$.

(1) *Coord.* $\bar{Y}$:

$$\bar{Y} = \frac{4}{\pi}\left[\frac{1}{3} + \frac{1}{5}\frac{A_3}{A_1} - \frac{1}{21}\frac{A_5}{A_1} + \frac{1}{45}\frac{A_7}{A_1}\right]$$

$$= \frac{4}{\pi}[.3333 + .0023 - .0008 + .0005]$$

$$= .427$$

(2) *Coord.* $\bar{X}$.

$$\bar{X} = Aa + (1 - A)X_T + (a - X_T) \cdot (a_1 + a_2\frac{A_3}{A_1} + a_3\frac{A_5}{A_1} + a_4\frac{A_7}{A_1})$$

$$= (1.3360 \times .25)c_0 - (.6 \times .3362)c_0 + (.25 - .6)c_0 \cdot \{-.5444 - (.2744 \times .01166) - (.0183 \times .0171) + (.0358 \times .0205)\}$$

$$= .3340c_0 - .2017c_0 - .35c_0\{-.5444 - .0032 - .0003 + .0007\}$$

$$= (.3340 - .2017 + .1915)c_0$$

$$= .324c_0.$$

Employing the approximate formula for $\bar{X}$, viz.:

$$\bar{X} = a(A + a_1) + (1 - \overline{A + a_1})X_T$$

we get:

$$\bar{X} = .323c_0$$

which is practically identical with the value found by the more accurate form.

Mean Aerodynamic Chord.—For this wing $\lambda = .40$; $\sigma = .40$. On substituting these values in (24) we obtain $\bar{C} = .866c_0$.

These results were verified by graphical integration of the appropriate fundamental formulae (assuming $K_N = K_L$).

Conclusion

Although it does not appear feasible to generalise the formulae (16) and (24) for a plan form of any arbitrary shape, nevertheless the corresponding results in the case of an elliptical plan form may be of some interest and are easily obtainable as follows:

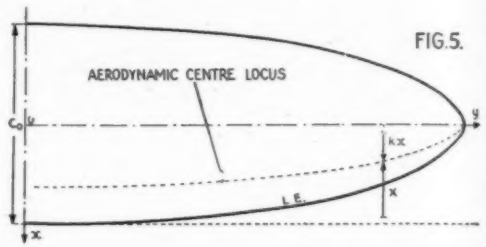


FIG. 5.

Taking the origin at the centre of the root chord and with the disposition of the axes in Fig. 5, the equation of the plan form will be:

$$\frac{x^2}{\left(\frac{c_0}{2}\right)^2} + \frac{y^2}{1} = 1$$

Assuming, as before, that the locus of aerodynamic centres intersects each chord at a constant fraction of its length, its ordinate at any point will be kx, where k is a constant whose theoretical value is $\frac{1}{2}$. The corresponding X is therefore $(\frac{1}{2}c_0 - kx)$.

Again, for an elliptical plan form, the lift loading is given simply by:

$$K_L\,c/c_0 = A_1 \sin\theta.$$

Substituting in (1), we then have:

$$\bar{X} = \frac{\int_0^1 A_1 \sin\theta \cdot (\frac{1}{2}c_0 - k\frac{c_0}{2}\sqrt{1 - y^2})\,dy}{\pi/4\,A_1}$$

$$= \frac{2c_0}{\pi}\int_{\pi/2}^{\pi} \sin\theta \cdot (1 - k\sin\theta) \cdot \sin\theta \cdot d\theta$$

$$= \left(\tfrac{1}{2} - \frac{4}{3\pi}k\right) \cdot c_0 \quad .. \quad .. \quad .. \quad .. \quad (26)$$

For $k = \frac{1}{2}$, this becomes $.288\,c_0$.

The lateral Coord. $\bar{Y}$ is, of course, by (9): .425.

Mean Aerodynamic Chord.

Here $(c/c_0)^2 = 1 - y^2$

$$\therefore \bar{C} = \frac{\int_0^1 (1 - y^2)\,dy}{\int_0^1 \sqrt{1 - y^2}\,dy} \cdot c_0$$

$$= \frac{8}{3\pi} \cdot c_0 \quad .. \quad .. \quad .. \quad .. \quad .. \quad (27)$$

$$= .850c_0.$$

In the preparation of this article I am indebted to Dr. Ing. G. V. Lachmann and Mr. R. S. Stafford, A.F.R.Ae.S. for a series of helpful suggestions.

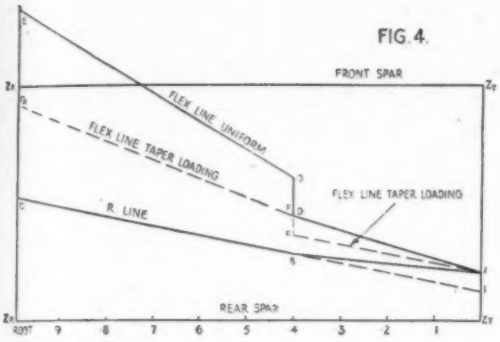
THE STRESSING OF MONOPLANE WINGS

Extension of Method to Non-straight "R" Line, Spars Still Parallel

By HAROLD N. HORNE

(*Continued from p. 19*)

FIG. 4.



THE method will now be extended to cover the case when the "R" line is not straight. (*Reference Fig.* 4).

(1) The values of "R" at points along the span are calculated and plotted as shown.

(2) Draw an "R" line composed of two (or more) straight lines through the points so calculated.

(3) Commencing at the tip draw the flexural lines for uniform and taper loading for the portion A.B. following the rules as for the previous example.

(4) To obtain the flexural lines for the portion B.C. proceed as follows :—

(*a*) Produce C.B. until it meets the $Z_T\ Z_T$ axis at P.

(*b*) From P draw lines of 2 and 3 times the slope of the portion of the "R" line B.C., over the same portion of the wing.

(*c*) Join the lines obtained for the portion A.B. to those obtained for the portion B.C. by lines parallel to the $Z_T\ Z_T$ axis.

(*d*) Interpolation between the flexural lines so obtained for the type of loading under consideration will give the corresponding flexural line.

Correction for Discontinuity

If the values of M/I for the two spars are now obtained it will be found that the spars would not deflect equally. This is due to the discontinuity at the point B.

A correction for this is given, the proof of which will not be included, being too lengthy, but it will be found that if applied, the correction gives the true values for shears, B.M.s and deflections of the spars.

The correction is to apply a concentrated torque at the point B. (i.e.) a concentrated load on each spar. The correction for the front spar is

$$\tfrac{1}{2}w\,x^2\left(\frac{dR}{dx}\ \text{inboard} - \frac{dR}{dx}\ \text{outboard}\right) \quad \text{(equation 3)}$$

where w is the loading at x, and the values of $\frac{dR}{dx}$ are the slopes of the two portions of the "R" line, the slope being positive when the distance from the rear spar to the "R" line is increasing when moving along the X X axis from the tip to the root. The correction for the rear spar is the same value but of opposite sign. This correction gives a constant increment to the shear curve inboard of the point of discontinuity.

Ref. Fig. 4.—The front and rear spars are parallel to the X X axis. The "R" line is shown as A.B.C.

FIG. 5a

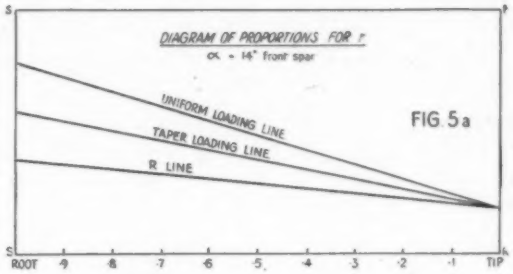
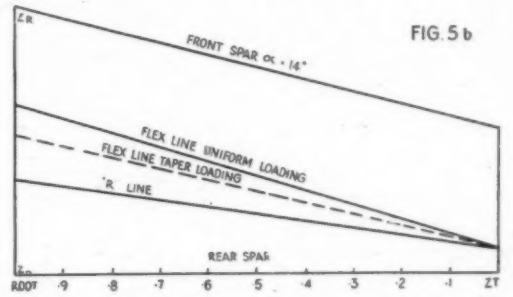


FIG. 5b



The flexural lines for the two cases of parallel loading and taper loading are shown as A.D.E. and A.F.G.

As before, interpolation between these latter, according to the type of loading under consideration, will give the flexural line. The shear curves for the two spars can now be obtained by applying the load along the flexural line and taking moments about either spar to obtain the individual spar loading.

It is to be noted that when drawing the shear diagram the correction is to be included as a constant quantity added or subtracted according to which spar is under consideration, the correction to commence at the point of discontinuity and to be applied over the rest of the wing inboard of that point. Integration of the shear curves gives the B.M. curves and as before it will be found that values for M/I at various points along the spars give the same value for each spar thus checking the flexural line.

Non-parallel Spars

To make the application perfectly general it will now be shown how the flexural line can be drawn when the spars are not parallel to each other

Referring to the general equation to the "R" line—

$$R = \frac{I_F \cos^3 \alpha_F}{I_F \cos^3 \alpha_F + I_R \cos^3 \alpha_R} \quad \text{(equation 4)}$$

where I_F = moment of inertia of front spar.
I_R = moment of inertia of rear spar.
α_F = Inclination of the front spar to the X X datum.
α_R = Inclination of the rear spar to the X X datum.

It must be noted that the values of "R" are ratios of the distance to the "R" line (measured from the rear spar) to the distance between the spars. When this is understood, it will be easy to understand the following procedure. (*Reference Fig.* 5 (*a and b*)).

1. Calculate "R" from the above equation (No. 4).
2. Draw two lines parallel to the X X axis F.S. R.S.

representing as regards length along the span, the front and rear spars respectively.

3. Measuring from the rear spar line plot the values of "R" as ratios of the distance between the lines representing the spars.

4. Proceed now to obtain the flexural line exactly as when the spars were parallel.

5. If points on the flexural line so obtained are now treated as ratios of the distances between the spars and so plotted, being measured from the rear spar, the true flexural line for the loading considered is obtained. If this procedure is followed the flexural line for any loading and non-parallel spars is found quite easily.

Example

As a final summary, an example in full will be given, which includes the various points considered, and from a perusal of this, and the previous descriptions given it should be possible to obtain quickly and easily a flexural line for any wing likely to be met with in practice.

The above method has been checked against values obtained by calculation by the method of R. and M. 1617, and the agreements was remarkably close, whilst the gain in time was considerable.

The final example is as follows:—"R" line straight, Spars not parallel. (*Reference Fig. 6, a, b, c, and d.*)

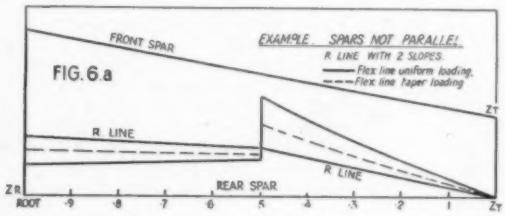
x/s	I_F	I_R	$I_F \cos^3 a_F$	$R = \frac{I_F \cos^3 a_F}{I_F \cos^3 a_F + I_R \cos^3 a_R}$
Tip	1.57	1.7	1.5	.47
.1	1.78	1.68	1.7	.496
.2	2.0	1.66	1.9	.535
.3	2.2	1.64	2.1	.562
.4	2.41	1.62	2.3	.586
.5	2.62	1.6	2.5	.61
.6	2.68	1.73	2.55	.595
.7	2.73	1.86	2.6	.583
.8	2.76	1.99	2.65	.571
.9	2.84	2.12	2.7	.56
Root	2.88	2.25	2.75	.55

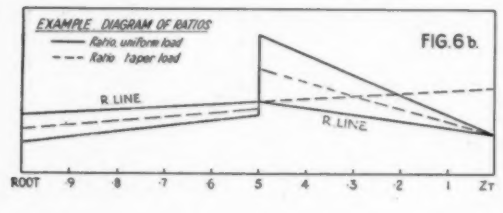
x/s	Ratio Uniform Load.	Ratio Taper Load.	Spar Centres.	r Uniform.	r Taper.
Tip	.47	.47	3.2	1.5	1.5
.1	.554	.53	3.38	1.87	1.79
.2	.636	.58	3.55	2.26	2.06
.3	.72	.636	3.73	2.68	2.36
.4	.804	.69	3.9	3.12	2.68
.5	.89	.75	4.08	3.63	3.06
.6	.524	.56	4.27	2.24	2.39
.7	.5	.544	4.45	2.22	2.42
.8	.48	.526	4.62	2.2	2.42
.9	.454	.51	4.8	2.18	2.44
Root	.43	.49	5	2.15	2.45

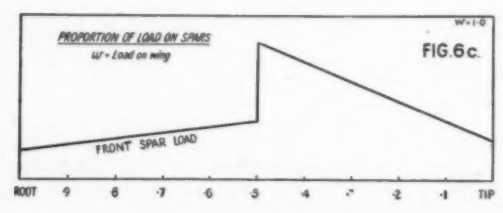
x/s	M_F	I_F	$\frac{MF}{I_F}$	M_R	I_R	$\frac{M_r}{I_R}$
Tip	—	1.57	—	—	1.7	—
.1	—	1.78	—	—	1.68	—
.2	—	2.0	—	—	1.66	—
.3	2.5	2.2	1.14	1.88	1.64	1.14
.4	4.6	2.41	1.91	3.14	1.62	1.93
.5	7.65	2.62	2.92	4.7	1.6	2.93
.6	11	2.68	4.1	7.0	1.73	4.05
.7	14.7	2.73	5.38	9.8	1.86	5.28
.8	19	2.76	6.9	13.2	1.99	6.7
.9	23.5	2.84	8.28	17.1	2.12	8.1
Root	28.9	2.88	10	21.5	2.25	9.6

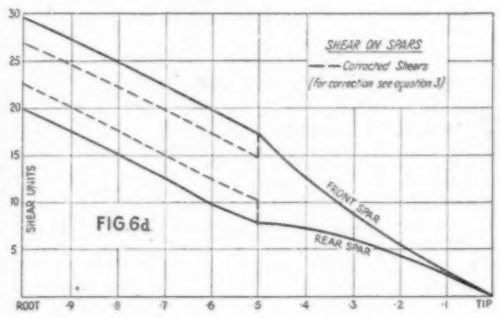
$aF = 10°$ $\quad \cos^3 aF = 0.955$
$aR = 0°$ $\quad \cos^3 aR = 1$

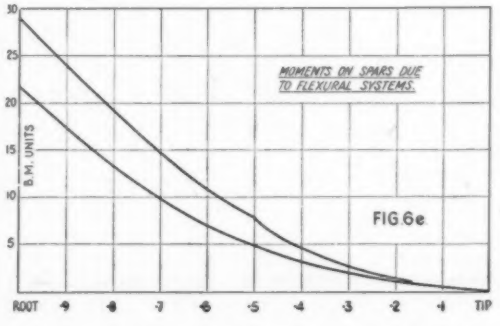
It will be seen from the above that if the values of $\frac{M}{I}$ are plotted for the two spars, and as deflections are proportional to $\frac{M}{I}$ the two spars would deflect equally along the axis X X. This therefore is the check that the flexural line derived is the line on which the load has to be applied to give no twist to the wing.











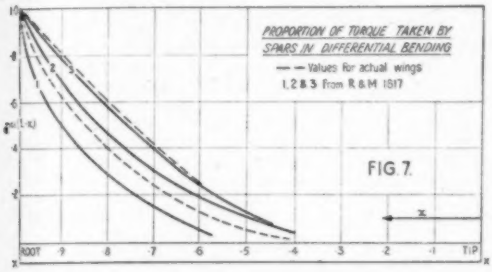
The complete load systems along the wing are now known; they are :—

(*a*) A flexural system as found above.

(*b*) A torque system.

This latter is obtained by taking the increment of load at any point along the span, multiplied by the distance from the line of centre of pressure, to the flexural line. The integration of this from the wing tip up to the section under consideration, gives the torque at that section. The method of apportioning this torque between the spars in differential bending, and shear on the skin, is given in R. and M. 1617 (1), and will not be dealt with here.

It may be of interest to the reader, however, to see how the curves given in that report compare with some derived from actual wings. These are given in Fig. 7.



Having distributed the torque between the spars and the skin, the total loadings on the spars are the combination of the loads found from the two systems.

In conclusion, it may be pointed out that in a case when the wing has a torque and no flexure (this is nearly so in the nose dive case) the flexural line is not required and the torque is dealt with as given in R. and M. 1617 (1). Once the principles have been grasped the application of the above method is quick and easy and has been found very useful when a wing is in the design stage.

Discontinuous Loadings

The method of obtaining the flexural line by drawing the lines for uniform loading and taper loading and interpolating between these, whilst being applicable to the general type of load curve on a monoplane wing, is not possible when the loading is discontinuous. This may be the case, when the wing is fitted with slots, flaps, or in some cases for a twisted wing. The following method is put forward to enable such cases to be dealt with simply.

(i) The "R" line is approximated by straight lines. (The simplicity of the method depends on this.) With this simplification the equation to the loading on the front spar becomes—

$$w_F = Rw + 2\frac{dR}{dx}\int_0^x w\,dx.$$

It is to be noted that, as $\frac{dR}{dx}$ is constant over each portion of the wing where the "R" line is straight, it is easy to obtain the front spar loading from the above and so the flexural line follows directly. (The flexural line is required to evaluate the torque.) Because of the discontinuity in the "R" line at each change point it is necessary, when evaluating the shear, to use the correction for this, i.e., $\frac{1}{2}wx^2\left(\frac{dR}{dx}\text{ inboard} - \frac{dR}{dx}\text{ outboard}\right)$ as was done previously.

This method owes its simplicity to the approximation of the "R" line by straight lines and the correction to allow for this. As it involves only one integration, which can be done graphically, the difficulty of graphical differentiation is eliminated.

STRUCTURAL DESIGN*

THIS book has been prepared as "a text for College students, presenting the basic principles and methods of metal airplane design." The author, John E. Younger, is Professor of Mechanical Engineering in the University of California and was formerly Senior Aeronautical Engineer at Wright Field. He has had the assistance, in preparing the book, of Raymond H. Rice, Chief of Stress Analysis Department, the Glenn L. Martin Company, and Nairne F. Ward, Assistant Professor of Mechanical Engineering, University of California, and Lecturer on Metallurgy and Welding, Boeing School of Aeronautics.

Such a combination of two engineering teachers and one practising engineer should produce a book suited to the capacity of the students for whom it is intended, and also thoroughly reliable from the point of view of the practical user. On the whole, these two characteristics have been achieved. Certain points will, however, have to be criticised, either for lack of clarity or for lack of soundness in the statement of fundamental principles.

The book is very well arranged and has been excellently produced and printed by the McGraw-Hill Publishing Co., Ltd. The only criticism of the production is that many of the pictures containing graphs are too small to be really useful, and in making this criticism we must admit the difficulty of making them larger without taking up too much space.

The most important portion of the book, from the point of view of the average user as distinct from the student, is Section IV, entitled "Special Problems in the Design of Metal Airplanes." This section of the book contains a valuable collation of data compiled almost entirely from American publications. The first chapter of this section deals with principles of sheet metal construction, and gives a number of useful theoretical empirical formulæ for the strength of tubes, curved sheets, corrugated sheets, etc., with illustrations of varying types of construction and different sections of longitudinal stiffeners for use in monocoque structures. It also covers the theory of thin webs in deep beams and gives information on the riveting and stiffening of such webs.

The second chapter deals with problems in cantilever wing design, and gives as much information on a difficult subject as can reasonably be expected in a students' textbook. In view of the complexity of the cantilever wing problem, it is quite reasonable to give an example which has been simplified by assuming that the moments of inertia of the spars remain in constant ratio to one another at every section along the wing. It is surprising, however, to be told that "further investigation is left for the student," when the problem is still definitely in the research stage.

The chapter on wing flutter and other structural vibrations is short, but again covers as much ground as can be expected, in view of the purpose of the book.

The chapter on riveting in aircraft construction is very good, and gives a large amount of information which will be found directly useful by designing draughtsmen as well as by students.

The last two chapters of the section and of the book come from the two assistant authors. Nairne F. Ward contributes an interesting and helpful chapter on welding in aircraft construction, and Raymond H. Rice gives a chapter on landing gear stress analysis.

We must now turn back to consider Section I, which bears the heading, "The Design Problem." Such a section is inevitably sketchy, but it is not on this ground that it is open

*Structional Design of Metal Airplanes, by John E. Younger, Raymond H. Rice and Nairne F. Ward. McGraw-Hill Publishing Co. Ltd., Price 24s. net.

to criticism. It is essential, however, that the general information that is given under such a heading should be completely sound. In the work dealing with the forces on the aircraft in the high angle of attack stressing case it is assumed that the longitudinal inertia forces will balance the parasite drag only, and the thrust is calculated on the basis of this assumption. It is surely more logical to calculate the thrust from the properties of the airscrew and to put in sufficient longitudinal inertia to balance the residue of wing drag and parasite drag which remains after the known thrust is subtracted. In the consideration of the vertical drive we are asked to assume that the parasite drag is zero. As the parasite drag is clearly higher at this speed than at any slower speeds, this is an unfortunate way of stating what is apparently a standard assumption in American stressing methods. The student will more readily understand what he is doing if it is stated that the whole weight of the machine is assumed to be supported by the drag of the wings alone, as a stressing case for the wings.

Finally, it is good to see that the practising engineer has caused the addition of a footnote explaining the factor of safety, as otherwise it would have been distressing to read the statement that "in aircraft work we have no such factor."

Metallurgical Details

Section II is contributed by the metallurgist, Nairne F. Ward, and headed "Available Materials." It comprises a summary, presented in an interesting manner, of the metallurgical and mechanical properties of a very wide range of materials that are used in aircraft construction.

Two further chapters deal with the "modification of properties of materials during fabrication" and the "protection of metals against corrosion."

The whole of this section is both interesting and helpful, but naturally cannot go deeply into the metallurgical aspects to which reference would naturally be made in specialised books.

We now come to Section III, on "basic and structural analysis." Here the only grumble comes right at the beginning. It seems unfortunate that page 78 should be devoted to emphasising, quite correctly, the extreme care which must be taken in drawing the vectors for the free body diagrams, and that page 79 should have an example of such a diagram, which is itself in error. The aeroplane, as drawn, would be in a state of permanent rotation, and the longitudinal locations of lift and weight should have been reversed in order to give equilibrium. After pointing this out, we are free to praise the remainder of this section as an excellent and clearly arranged summary of the various problems which confront the aircraft stressman.

The chapter on statically indeterminate structures gives helpful illustrations of the effects of initial stresses in members and a description of strain energy calculations, which should be readily understood. It might, however, have been desirable to state at the start that the statically determinate structure, as defined, must have all its members freely pin-jointed.

American Formulæ

The next chapter deals with beams and struts, and includes a number of charts and design formulæ for struts of different kinds, under different loadings. The formulæ are those used in America, and are, therefore, not directly applicable for British airworthiness calculations. The charts for tubes under combined bending and compression should be useful, as nothing similar appears in any British publication of which the writer is aware.

The last two chapters cover continuous beam columns and problems in torsion. The method of dealing with continuous beams is that which is apparently in general use in America, and differs principally from the British Berry method in using an angle of double the amount.

There is no reference to the H. B. Howard polar diagrams, although the bibliography at the end of the chapter refers to his book on "Stresses in Aeroplane Structures." Incidentally, we may mention that the selected references at the end of each chapter will be found very useful.

The chapter on torsion covers a wide variety of formulæ, and gives empirical results for tubes based, in part, on the author's own researches.

Stressed-Skin Data

This book has been made the subject of a long and detailed review because it should prove of value and interest to many readers. It has been written from an unusual angle, and is probably the first book, at any rate in the English language, to cover metallurgical and practical details, in addition to considering, so far as its scope permits, the technical problems of strength calculation. Incidentally, the selected references at the end of each chapter are a good feature, which other authors might more frequently imitate, but it is surprising to find only one British R. & M. included, although several British books are mentioned. It is probably safe to say that there is more information on stressed-skin construction in this book than in any previously published, but to those who may expect too much we quote from the book itself: "The exact type of construction will, of course, be the result of careful study by the engineering force for the specific job. The final design will be the result of successive approximations of trials, much study, ingenuity, and a large number of experiments."

H. A. M.

B.S.I. SPECIFICATIONS

Steel Sheets and Strip

THE following new and revised British Standard Specifications for Steel Sheets and Strips for Aircraft have just been published by the British Standards Institution:—

3 S.3. *Mild Steel Sheets and Strips (suitable for Welding).*—A revision of B.S. Specification 2 S.3, which hitherto has been confined to Sheet material. The revised specification covers both Sheets and Strips supplied in the rolled and re-heated condition. An 0.1 per cent. proof stress of not less than 16 tons per sq. in. is required.

3 S.4. *5 per cent. Nickel Steel Sheets (not suitable for Welding).*—A revision of B.S. Specification 2 S.4, the principal alteration being the inclusion of a 0.1 per cent. proof stress test of not less than 40 tons per sq. in. on the hardened and tempered samples

S.84. *Low Carbon Steel Sheets and Strips (suitable for Welding).*—This specification replaces the Air Ministry Specifications D.T D. 12A and 141 and is intended for Water Jackets, Exhaust Manifolds and low-stressed aircraft parts.

S.85. *Non-corrodible Steel Sheets.* This specification replaces the Air Ministry Specification D.T.D. 23B. An 0.1 per cent. proof stress of not less than 16 tons per sq. in. has been included.

S.86. *Nickel-Chromium Steel Sheets and Strips (40-50 Tons—0.1 per cent. Proof Stress).*—This specification replaces the Air Ministry Specifications D.T.D. 98A and 100, and covers Softened Sheets and Strips, Hardened and Tempered Strips, Strips as cold rolled and Strips as cold rolled and afterwards tempered.

S.87. *Nickel-Chromium Steel Strips (55-65 Tons, 0.1 per cent. Proof Stress).*—This specification replaces the Air Ministry specification D.T.D. 99 and covers both Softened and Hardened and Tempered Strips.

S.88. *Nickel-Chromium Steel Strips (65-75 Tons, 0.1 per cent. Proof Stress).*—This specification replaces the Air Ministry Specification No. 54A and two qualities defined as A and B, quality A having better bending properties in the hardened and tempered condition, although the tensile values are the same.

Copies of these Specifications may be obtained from the British Standards Institution, Publications Department, 28, Victoria Street, London, S.W.1, price 1s. 2d. each, post free (7s. 4d. the set of 7).

A REAL FLYING SHOWROOM

More than Fifty Instruments and Items of Equipment Marketed by Smith's Aircraft Instruments Carried in D.H. Dragon : A Tour Abroad

WHEN it leaves England in a few days' time on a tour of the Scandinavian and Baltic countries, the D.H. Dragon purchased by Smith's Aircraft Instruments will carry almost every type of instrument and aircraft accessory known at the present time. All are makes marketed by Smith's, and the fact that the machine carries more than fifty items is an indication of the scope and range of the material handled by that firm. Among the towns to be visited will, of course, be Stockholm, which will be reached during the period of the exhibition.

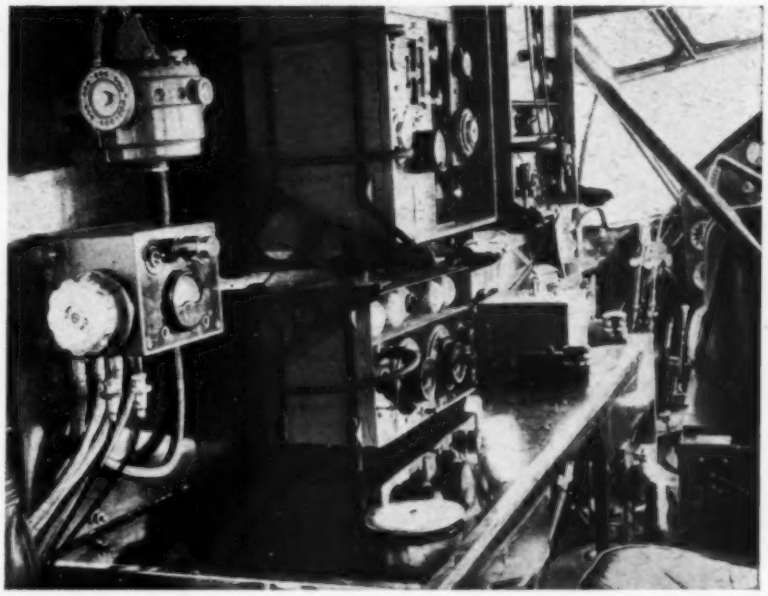
The installation of all this equipment in the Dragon was entrusted to Airwork, Ltd., of Heston, under the supervision of Mr. H. M. Samuelson, who will pilot the machine on its tour. A number of people interested in the machine and its equipment were privileged to inspect it at Heston last Friday, when demonstrations were given. The Lorenz blind-landing equipment was not yet functioning, but as far as possible the rest of the equipment was demonstrated.

Mention can be made here only of the principal equipment carried in the Dragon. In the matter of bulk, the automatic pilot (three-axes type) looms largest, followed by the Standard transmitting and receiving radio equipment. Among the navigational equipment are Husun compasses, R.C. direction-finder and radio compass, floor-type drift sight with control, and Addison-Loard course and wind calculator. Provision is made for installing in the floor a Wimperis course-setting bomb sight, which makes a first-class navigation instrument. A Williamson "Eagle" camera can be mounted over the same opening as an alternative.

A large variety of engine instruments are also carried, such as "Record" electrical rev. indicators, large-dial rev. indicators mounted on the engines, oil temperature and pressure gauges, electric fuel contents gauges, and so forth.

The range of Smith's aircraft instruments includes altimeter with pressure gauge, airspeed indicator, rate-of-climb indicator, turn indicator, and fore-and-aft and cross levels.

Three windmill-driven electric generators are mounted externally, two on the wings and one under the fuselage, and in addition to the fairlead for the ordinary radio there is a short vertical mast on top of the fuselage and a short rail underneath, these being the aerials for the short-wave equipment. In spite of these excrescences it is understood that the speed of the Dragon has dropped only about 2 m.p.h.

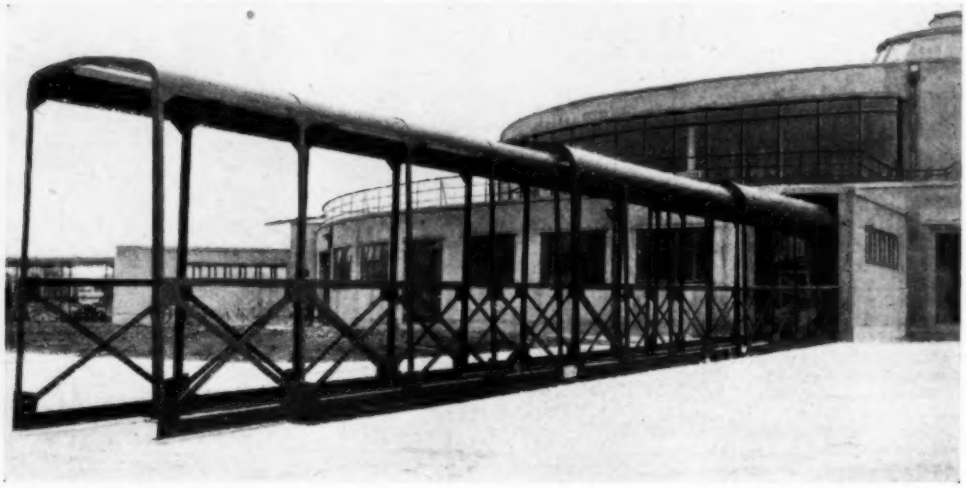


The major part of the equipment of the "Flying Showroom" is arranged immediately behind what is normally the bulkhead of the Dragon. On the left is the Standard radio compass, while the various details of the other radio equipment are nearer the cockpit. (*Flight* photograph.)

On the left is an interior view of the rear of the Dragon's cabin with the automatic pilots for the three axes in their transparent covers and the rotating loop for the radio compass. The exterior view above shows two of the three generators, a landing light and the short and long-wave aerial systems. (*Flight* photographs.)

COMMERCIAL AVIATION

AIRLINES — AIRPORTS



THINGS TO COME: An impression of the Gatwick terminal building, showing one of the six telescopic entrance "gangways." The airport will be opened by Viscount Swinton on June 6. British Airways and several charter firms will make it their operating base and Railway Air Services will be using it for their southern extensions. (*Flight* photograph.)

THE WEEK AT CROYDON

"Hanno" Back : Coach Comfort : Getting in the Wrong Aeroplane : Guinea Pigs—without Top Hats—Fly to Copenhagen

A REGISTRATION we have not seen overhead at Croydon for some considerable time was observed last week when G-AAUD, better known as *Hanno*, was flown by Capt. Perry for the first time after a spot of bother at Kisumu last autumn. The machine has been rebuilt at Croydon, and on Monday Capt. Rogers left for Cairo with it. They will be welcomed warmly on the Empire routes in this season of intensive flying, when every machine is needed.

Last week I noticed a couple of new Imperial Airways' passenger coaches at the Airport, painted in silver and grey, and beautifully upholstered internally. Whoever worked out the colour scheme and general effect deserves full marks, for these vehicles are really worthy of the comfortable and effective aircraft they serve. Curiously enough, there is a tendency to forget that the air journey begins and ends at the city centres, and to employ road transport unworthy of the standard of the aeroplanes. For example, how many road vehicles are internally warmed? Early morning passengers leaving London at about 6 a.m. can be thoroughly chilled before reaching Croydon, and passengers in raw weather, who have just arrived in nicely warmed aeroplanes, do not want chilling off for 35 to 45 minutes in an ice-cold coach.

The K.L.M. people are remarkably busy these days, with five services each way daily in and out of Croydon, the first at 7 a.m. outwards and the last inward at 10 p.m. Also, K.L.M. at Croydon has just started overnight bookings as well as the day work in this respect, so that the office is open for the whole twenty-four hours. Bookings are said to be remarkably good, and the "business man's express" at 7.45 p.m. from Croydon is, as in previous years, very popular with Dutch business men, who prefer to sleep at home instead of tossing feverishly on the briny deep all night.

One of the Imperial Airways' passengers recently was a nine months old baby from Croydon to Entebbe, Africa. Supplies of special baby food were ordered all along the line to the alarm of bachelor station superintendents. It is not, however, strictly true that one of these, told to get in a supply of "Cow and Gate," and ever anxious to oblige, paraded to meet the aircraft with a door and a goat, that being the best he could manage in the face of local difficulties.

Rollason Aircraft, Ltd., have just taken another hangar in order to separate the servicing and maintenance side from other work. They are, of course, servicing the extensive air lines operated by British Continental Airways, Ltd., with whom Rollasons are very closely associated. Personal Airways, Ltd.—the new company of which Capt. "Bill" Ledlie is a co-director with the Hon. Peter Beatty and the Hon. Peter Pleydell-Bouverie—is also serviced by "the Rollason men." Rollasons now have in hand, among other work, a Dragon from Western Airways, Ltd., for overhaul, and the second Imperial Airways Wessex, which is to be fitted with dual control.

Newspapers were all worked up on Saturday and Sunday last about the alleged traveller by K.L.M. from Holland, who, while seeing his friends off, was carried away in the evening machine and landed at Croydon before he was aware of having started. Actually, it was a very ordinary case of a man making a last-minute decision to accompany his friends to England, stay the night with them and return by the 7 a.m. machine from Croydon next morning, which landed him in Holland at 9 a.m., in time for the day's work. He was an ordinary fare-paying pas-

senger who took his ticket in Holland before leaving. It is practically impossible to travel "accidentally," owing to the strict supervision of passengers before the start. Heads are counted, and the only case of a mistake I remember was when a passenger destined for (say) Cologne and another for Paris innocently occupied each other's seats in two aeroplanes standing side by side on the tarmac. Even that was discovered before the take-off.

Incidentally, a person carried off by accident would only have to draw the steward's attention to his plight, either when taxying or immediately after the take-off, and the pilot would return to the departure platform to disembark him. Air companies, however, are not so easily taken in, for the passenger list and official load sheet must tally exactly with what is aboard, otherwise overloading might be the result.

British Continental Airways, Ltd., had a consignment of 150 guinea-pigs to Copenhagen recently. It is not yet known if these prolific little creatures doubled their numbers before arrival. One imagines the consignee, confronted with 300 of them, remarking, "My goodness, my guinea-pigs," and thereafter demanding a guinea a pig for those born some 2,000ft. above the earth's surface.

Miss Ruth Rogers, amateur cinematographer, returned last week by Imperial Airways from India. Arriving with some 4,000ft. of exposed film, she was astonished, according to newspaper accounts, to have to pay duty on it. After all, this is a normal Customs duty, and it is better to acquaint oneself with such regulations before making these trips. Customs will always inform people in advance on these questions.

Croydon assumed its usual festive appearance on Cup Tie Day, owing to the swarms of beribboned and rosetted supporters who arrived in some twenty huge coaches at about 7 a.m. Mr. "Joe" Chamberlain was there as usual to mesmerise them into flying by "Surreys," and most of the flights were made by Capt. "Timber" Woods. So far as this firm alone was concerned, some two hundred gentlemen "oop for t'coop" were taken "oop in t'air."

A. VIATOR.

THE RAILWAYS MOVE ON

Big Extensions to Railway Air Services' Regular Routes : Co-ordinated Ground and Air Transport Facilities : The New Fleet

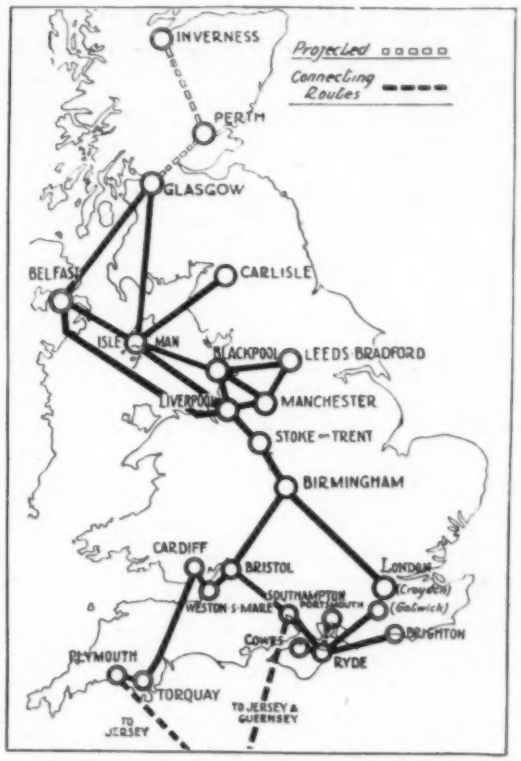
WITH other companies making plans for the 1936 flying season it was not to be expected that Railway Air Services would mark time, and the fact that considerable extensions and accelerations are due on and after Monday, May 25, should not surprise anyone. Orders have been placed or executed for eight new machines—two D.H.86 As, Series II, and six D.H.89s (Dragon Rapides), of which three have already been delivered—which will increase the fleet to eighteen, and sixty-two regular services will be operated. As before, the personnel will consist of Imperial Airways pilots, radio operators and engineers, and most of the maintenance work will be carried out at Croydon.

The new network is, of course, again planned around the main trunk route between London (Croydon), Belfast and Glasgow, which service will be continued to its present schedules—these are, of course, largely regulated by mail considerations—but the flying times will be reduced over certain sections. In addition to this and one between Belfast and the Isle of Man, an afternoon service from Manchester and Liverpool will be operated to Belfast, which is also connected with Glasgow by two services daily, and there is a possibility that the northern section will be extended to Perth and Inverness. Two of the services from the Isle of Man to Liverpool will provide connections with fast London trains—a very important point, since the real time is saved during the sea crossing.

In the South

Bristol will form a connecting point for services between the Midland and Northern towns, and the Isle of Wight, Brighton, Weston-super-Mare, Torquay and Plymouth—from whence Jersey Airways fly daily to Jersey. Gatwick, which is connected with Victoria by fast electric train services, will be used as the London terminus of the various Isle of Wight services.

More important, perhaps, than anything in the mind of the ordinary traveller is the fact that arrangements have been made by which passengers by R.A.S. may always return by first-class railway and steamer services, or, alternatively, railway or steamer travellers may return by air on payment of supplements, and heavy luggage can, of course, be collected and carried by rail with the ordinary "luggage in advance." Holders of season tickets are also allowed a 10 per cent. reduction on the normal air fares within the area covered by their seasons. The ability to make air bookings at any station, as well as at the normal travel agencies, will also help to get those people into the air who complain that they "didn't know that there was an air service." There is no doubt that R.A.S. can and will do a very great deal to encourage public air travel.



The Railway Air Services route map as it will appear on and after May 25

New Flying Boat for Air France

FLYING boat development in France is not confined to craft for Air France's South Atlantic route. Bigger machines are being experimented with for use on the North Atlantic, and the requirements of the Mediterranean line—the daily 500-mile crossing between Marseilles and Algiers—have called forth the production of a new 26-seater flying boat to take the place of the fleet of twelve Lioré et Olivier 28as at present being used on that service.

This new flying boat, also by Lioré et Olivier, is known as the 246, and has four 690 h.p. partially supercharged Hispano-Suiza engines arranged in line along the leading edge of the wings. It has variable-pitch airscrews and a top speed of 210 m.p.h. Its total weight is just under 30,000 lb.

Commercial Aviation

STREAMLINE SKIS: The first D.H. Rapide to be fitted with skis in Canada. These are, it is believed, the first streamline skis to be fitted to a transport machine and have positive pitching movements about the axle.

A New Hire Service

SINCE Capt. E. D. Ayre joined Phillips and Powis Aircraft a new department has been opened by this company for the purpose of hiring Hawk Major and Falcon Major machines at daily or hourly rates. Capt. Ayre is in charge of this department and will arrange the necessary formalities for anyone wishing to tour abroad.

The rates are £4 a day for the Hawk and £5 5s. a day for the Falcon, with reductions to £3 and £4 10s. for three or more days. These figures include insurance. Machines may also be hired at £2 16s. and £3 an hour respectively, inclusive of insurance, petrol and oil.

This service is particularly interesting in that the normal club pilot rarely has an opportunity of flying these types.

Competition in Scandinavia

A COMPETITION for the Scandinavian Cup will be arranged to coincide with the opening of Stockholm's new airport at Bromma next month. This competition includes landing tests and navigation tests, and on May 21 entrants from Sweden, Denmark, Norway and Finland will set out, with subsequent tests during the following two days.

A number of secret time-controls will be arranged in addition to the official checks. It is stated that about fifty Scandinavian competitors have been entered, and that the Danish Air Force alone are sending ten army and three naval machines to participate.

The Austrian Whitsun Tour

INVITATIONS are now being sent out for the "Whitsun-flight 1936," organised by the Austrian and Swiss Aero Clubs and the Magyar Aero Szorvetseg. This international tour, which will be under the direct leadership of the Austrian Vice-Chancellor, Prince Starhemberg, and the Minister of Trade, Herr Stockinger, will start at Klagenfurt, and proceed *via* Graz to Budapest, and thence to Vienna, Linz, Salzburg, Innsbruck, Altenrhein, Lausanne and Basle. As already announced in *Flight*, ground marks will be placed *en route*, and at the end of the tour a prize will be awarded to the pilot who makes the most correct map entries regarding these marks. Applications should be made before May 15 to The Austrian Aero Club, Wien I, Naglergasse, 2. The period of the tour is May 28 to June 3.

Another Dawn Service

IN addition to their present "Dawn Express," Air Dispatch will run a second service to Paris on and after May 15. This service, which will be known as the "Blue 'Plane," will leave Croydon at 10 a.m. and leave Le Bourget on the return trip at 1 p.m. An interesting innovation on this service is the fact that a stewardess will be carried. The machines used will be Airspeed Envoys.

The Air Dispatch service to Le Touquet, which was very busy during the Easter holidays, will be run again at Whitsun, after which it will operate regularly during the summer.

All the Way

ARRANGEMENTS have now been completed which will enable a twice-weekly air mail service to be flown through in each direction between London and Brisbane. A twice-weekly service between London and Singapore has been operated since September, 1935, and the first of the duplicated services over the Singapore-Brisbane sections will leave Singapore for Brisbane on May 14, connecting with the arrival at Singapore of the service leaving London on May 6. In the reverse direction the first service by Qantas Empire Airways will leave Brisbane on May 16.

Brightoving Airport

THE official opening of the Brighton, Hove and Worthing Airport at Shoreham is being celebrated with a two-day international flying meeting. This meeting will open with an arrival competition (11.30 a.m. to 12.30 p.m.) for which there will be a £50 prize.

There will be a display on Saturday afternoon which will be supported by the R.A.F., and another display on Sunday at which a limited number of foreign visitors will be able to participate. On the same day there will also be a handicap race for which there will be cups and £85 in prizes.

During the two days foreign visitors will be guests of the three towns.

A Question of Liability

THE need for the absolute necessity of reading an agreement very thoroughly before hiring an aeroplane must have been obvious to anyone who followed a recent case at the Croydon County Court. In the ordinary way these agreements are as fair as they can possibly be to both parties, and the hirer has only himself to blame if he fails to understand, for instance, the "excess" clause in the matter of insurance cover.

Mr. Edward W. H. H. Cavendish, of Park Hill, Clapham Park, claimed £51 13s. from Mr. W. G. M. Broomhall and Miss E. M. Paton, The Hawthorns, Great Bookham, for the hire of an aeroplane belonging to the plaintiff. The defendants counter-claimed for £8 8s. damages.

The plaintiff's case was that the aeroplane was brought down by Mr. Broomhall in a most unsuitable place at Morden—a former golf course now being turned into a building estate, on Sunday, February 9. Mr. Broomhall said that there was a haze and he thought it was better to come down. The machine was removed by lorry by Rollason Aircraft Services, of Croydon Aerodrome, but they refused to return it until their account was paid. It was returned on Thursday and Capt. Holmes, who assisted Mr. Cavendish in his business, told Mr. Broomhall that they had lost a lot of money through not having the machine. He offered to call the whole thing off if Mr. Broomhall "sent along a tenner," but this was not done until much later.

The defendants claimed that the lights on the machine were defective and Mr. Broomhall could not fly on to Croydon.

The judge held that the contract was entered into by Mr. Broomhall on behalf of Miss Paton and that he was entitled to be dismissed from the action with costs. The return to Croydon was not that contemplated in the agreement, and he was not satisfied that there was any defect or breach of warranty in respect of the machine.

It was agreed that the claim should be reduced to £40 3s., and judgment was given for Mr. Cavendish for this amount, for Mr. Broomhall with costs, and the counter-claim was dismissed with costs.

An amusing sidelight on the whole unfortunate affair concerned the fact that, after the mishap, Mr. Broomhall was prevented by the police from returning to the machine after telephoning, since he was wearing carpet slippers and could not possibly be the pilot!

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for publication in these columns.

AN APPRECIATION

AS a private owner, I must compliment you on last week's Light Aircraft Number of *Flight*. It is one of the most informative and useful issues of any paper in the flying world that, in my opinion, has ever been produced, and for many weeks will make a good work of reference.

May I suggest to those of your advertisers who do not state their prices in their advertisements, that it would be a great convenience to your readers if they were to do so, and lead to more and quicker business? S. HARRIS.

Caterham Valley, Surrey.

[Many similar letters have reached *Flight*, and we tender their writers our sincere thanks.—ED.]

THOSE LANDING FEES

MOST private owners, and club members generally, will regret the passing of the fraternity spirit which used to exist—a passing in consequence of the new practice, existing at some aerodromes, of charging landing fees.

In the olden days one felt that one was a welcome visitor at every club, just as we welcomed others at clubs of which I happen to be a member. On a fine day a private pilot could land at three or four club aerodromes, looking up friends, etc., without having to pay a series of landing fees, but that is likely to be changed if the new practice is to be maintained. Furthermore, there is bound to arise certain hostility between clubs, and also between commercial pilots and those clubs which operate on privately owned aerodromes where no landing fees are at present charged. The latter clubs must in future recipricate, making the landing fee a universal charge, which may hit the commercial operator very hard.

I know of a case where a large, heavily laden air liner was weatherbound and landed for a short while at one of such aerodromes, the owner of which adopts the public-spirited policy that he is out to help commercial and private flying in any way possible, and used to make no charge to visitors. He tells me that he would have been entitled to charge £4 5s. as a landing fee in this particular case, and in future is going to charge commercial operators according to scale.

Frankly, I think that the practice will prove to be one which is harmful all round, though the sordid commercial arguments in its favour are obvious. Is it too late for those who have adopted it to think again?

Coventry. ERIC W. WALFORD.

ULTRA-LIGHT

THE following remarks concerning Mr. Boddy's article in *Flight* of April 9 may perhaps come too late, or may have been anticipated by those of other contributors. Nevertheless, I wish to write because—though neither of us is American—Mr. Boddy in his article "gets my goat." The author is astonished that really small machines are not offered in the market to a larger extent than is the case at present, and his article is more or less an appeal to the industry to go in for this "attractive" market.

One might answer simply, that the very fact that this really small machine is *not* in the market is the *best* proof that there is very little use for it!

Mr. Boddy has gone to great lengths to prove his point, and is therefore entitled to a more detailed answer.

This matter of the ultra-light aeroplane is quite old already. I remember that some fifteen or sixteen years ago the subject was very much in the limelight, and gave rise to furious controversies in which we went for each other hammer and tongs. At that time I stated my opinion in a few sentences:—

Flying, in order to be interesting and amusing, has to take one of the following forms.

First, flying purely as *sport*, providing the satisfaction of a difficult feat well done. That means aerobatics and/or rough-weather flying. Nice-weather flying, purely as such, may give some satisfaction to the embryo pilot, but once the novelty has worn off such flying is no longer sport.

The ultra-light aeroplane is not the kind of thing one requires either for aerobatics or for rough-weather flying.

The second form of flying is that of the *tourist*, and here we must differentiate between the tourist who makes small excursions and the long-distance tourist who wishes to use his aeroplane to see the world.

From the point of view of the ultra-light aeroplane we may dismiss this last-named category. When one goes in for long-distance touring one needs a machine with a cruising speed of *over* 110 m.p.h. A 330 miles stretch then means less than three hours' flying in calm weather, or, with a strong head wind of 35 m.p.h., not quite four and a half hours, which is well within the tank capacity of a normal private-owner machine. But fancy the "ultra-light" in such a case. Taking Mr. Boddy's figure of 80 m.p.h. cruising speed—that means that with this same 35 m.p.h. head wind the poor thing would be reduced to 45 m.p.h.! For this purpose the "ultra-light" is definitely out of the running!

There is, however, the humbler form of touring, just to see friends some 100 or 150 miles away, or to play a round of golf at some outlying course. This is what most of the propagandists of the "ultra-light" have in mind when they foresee its use as a supplanter of the motor car.

However, what is the chief pleasure of such excursions by car? Without a doubt, the intervening country—the close touch in which one is with a constantly changing landscape. In an aeroplane this means "hedge-hopping." Well, I think we all agree that "hedge-hopping" in a good aeroplane is highly diverting and certainly a pleasure. It is, on the other hand, a thing which should *not* be encouraged! But, alas, once one takes a sensible altitude the pleasure of aerial touring soon changes to boredom. Certainly so when the country over which one flies is one's own and therefore well known. Just seeing an aerial map of one's country slowly being pulled under one's feet may please the beginner, but this pleasure soon wears off.

I firmly believe that, apart from other considerations, this "boredom" is a deterrent to the development of private flying from the touristic point of view.

Well, it simply means that we must get nearer to that "hedge-hopping" which we just now thought unwise. But why do we consider it dangerous? Because of that inherent characteristic of the aeroplane, that it requires forward speed up to the last moment when it touches the ground again. Once this difficulty will have been overcome, once the perfect flying machine—able to stand still in the air, to descend vertically, to rise vertically, and to develop horizontally any speed between zero and a good maximum—will have been invented, we can go "hedge-hopping" as much as we like. [Owners of hedges permitting.—ED.] But not till then will there be an interesting market for these "ultra-lights" as supplanters of the motor car!

Ankara, Turkey. B. STEPHAN.

RUSH-HOUR ON THE ETHER

I THINK anybody who, like myself, was operating an aircraft radio installation during the busy days of the Easter holiday will heartily agree with me when I say that the "jamming" was at times phenomenal. The Croydon Control operator could probably endorse this also. It was sometimes necessary to wait several minutes to get a message through, and the reception of weak signals from a distant station or aircraft was often impossible.

The question must necessarily arise as to whether, in such circumstances, radio contributes in any way to the safety of aircraft passengers and crew, as it is doubtful whether adequate warning could be given of aircraft in the vicinity of any given machine in time to prevent collision. But what is, to my mind, a far graver matter is whether a machine in immediate danger and sending its S O S could be heard and located in the few seconds occupied by such a transmission. I think most people will agree that considerable doubt exists, and I suggest that such doubt should be removed as far as is humanly possible.

A method which occurs to me is to have an emergency switch alongside the operator's key which, by a single movement, would change the wavelength of the transmitter to some determined band well apart from that assigned to normal working. This band should be used solely and entirely for S O S messages, and a continuous listening watch kept on it at all main ground stations.

It should be fairly simple to modify existing radio installations to conform to this arrangement, and the only additional expense to the ground authorities would be the employment of an extra operator or so.

Croydon Airport. C. B. G. ROBINSON.

THE ROYAL AIR FORCE

SERVICE NOTES AND NEWS — AIR MINISTRY ANNOUNCEMENTS

No. 3 FLYING TRAINING SCHOOL

The undermentioned officers and airman pilots have been awarded special assessments as shown hereunder on completion of a course of *ab initio* flying training at No. 3 Flying Training School, Grantham:—

Special Distinction

A./Sgt. Flynn, F. R.

Distinguished Pass

A.P/O. G. V. Fryer, A.P/O. A. de V. Leach, A.P/O. M. M. J. Stevens, A.P/O. R. N. Wardell, A.P/O. D. K. Banks, A./Sgt. Marpole, R. H.

No. 6 FLYING TRAINING SCHOOL

The undermentioned officers and airman pilots have been awarded special assessments as shown hereunder on completion of a course of *ab initio* flying training at No. 6 Flying Training School, Netheravon:—

Special Distinction

A.P/O. P. J. H. Harrington, A./Sgt. Hammond, W.N.

Distinguished Pass

P/O. H. H. Peck, A.P/O. J. B. W. Smith, A./Sgt. Turner, G. A., A./Sgt. Saunders, T.O.

LONG-SERVICE AND GOOD CONDUCT MEDALS

The Long Service and Good Conduct Medal has been awarded to the undermentioned airmen:—

W.O.s Bradshaw, J., Bugden, J. H. D., Davies, A. E., Hucker, L. G., Lamb, J. W.; W.O.2.s Eden, D. L., Hallett, W. T., Robinson, W.; Flt. Sergts. Addis, T. H., Bamsey, H., Basham, G. E., Bennett, A. E., Biggs, H. W., Bolton, F. H., Bowen, J. D., Boyes, W. H., Braund, E. W., Brown, P., Chambers, J. A., Cheeseman, E. G., Chitty, F. F. W., Cockerline, A. L., Coffee, J. F., Coleman, H. J., Coppin, H. J., A.F.M., Darrant, J. S., Deane, E. D., M.M., Downing, W. P., Durman, E. H., Fennell, F. G., Flexen, E. J., Gardner, N., D.F.M., Geer, S. W., M.M., Gordon, S., Hammock, G. H., Hancock, R. W. V., Hards, J. B., Hazel, F. H. R., Herbert, W. H., Hills, W. H., D.C.M., Honey, P., Hughes, E. A., Hughes, H. V., A.F.M., Hunt, C. F., Hunter, J. M., James, W. J., Keeble, E. A., Kendall, A. B., Kettley, J. R., King, A. R. B., Lapidge, W. S. L., Lewis, F. C., Lord, F., Lucas, C. H., Lush, C., Lyons, T., Mann, J., Marshall, J. C., Martin, A. T., Matthews, H. G. G., Miller, A. E., Newton, H. K., Paine, J. A., Partridge, F. A., Pearce, W. F. C., Pearson, R. C., Pike, P. A. W., Pink, W. N., Potter, D. G., Ratcliffe, W. R., Robertson, R. S., Robinson, J. A. C., Rowe, F. H. H., Saddington, C. R., Sawyer, W. W. T., Scullard, L., Smith, S. W. E., Stead, T. S. C., Tebb, G. W., Thompson, A. E., Walters, H., Ward, F. H., Westwood, E. F., White, F. F., Whiting, H. F., Womersley, W. G., Wren, D. E.; Sergts. Allen, B. D., Atkinson, T. D., M.C., Batt, S. T., Bensted, C. F., Birt, S. E., Blayney, J. F., Bracher, A. T., Brooks, F., Carter, H. W., Chadwick, H. H., Chapple, R., Clarke, J., Clarke, W. G., Clements, S. G., Collins, J. A. E., Copeland, W. E., Davey, A. E., Durbridge, G. W. K., Easton, C. F., Etteridge, A. W. E., Evans, W., Fletcher, F. E., Foord, G. O., Gale, F. A., Gibbons, R. J., Hall, R. G., Hamilton, H. H., Harrad, W. J., Harris, W. H., Hayward, L. G., Heath, W., Heyworth, W. H., Hill, H. J., Hobbs, W. H. H., Howe, W. W., Howlett, B. C., Humphryes, A., Kenny, H. T., Knell, A. T., M.M., Lanyon, G. A., Lewis, A. T., McArdle, A., Marriott, J. W., Mayer, G. A., Mold, R. V., Morrad, H., Newport, H. W., Norton, A. E., Otten, J. F., Page, F. W., Patrick, J. McF., Prowse, P. M., Purvis, M. P., M.M., Ralph, J., Randall, A., Reed, W. H., Roberts, F. J., Rogers, G. W., Shaw, J. H., Smaje, C., Smith, H. V., Stickland, L. A., Sutton, W. E., Whale, A. P., White, C. A. G., White, F. G., White, H. F., Wilkinson, J. E. M., Wilson, F. J., Wilson, M. W., Wright, A. J. A.; Cpl./A./Sgt. Balsdon, E. A.T.; Cpl. Batty, F. H.; Cpl./A./Sgt. Berry, W. S.; Cpls. Bishop, J., Booth, S., Bourne, W. T., Briggs, J., Crispin, A. E., Davey, W. H.; Cpl./A./Sgt. De Souza, S. A. J.; Cpl. Dixon, W.; Cpl./A./Sgt. Evans, E. J.; Cpls. Evans, R. G., Flannigan, T., Gallagher, D., Gill, C. S., Goldstone, A., Graham, W. G., Green, A. J., Green, H. W., Greenway, T. R.; Cpl./A./Sgt. Guest, H. H. G.; Cpls. Gwilliam, E. H., Hansford, M.; Cpl./A./Sgts. Hewitt, W. H. E., Hodge, H. R.; Cpls. Howell, C., Jacobs, P. M.; Cpl./A./Sgt. Jory, R. J. P.; Cpls. Latham, G., McDermott, A. G., May, W. T., Miles, C. G., Newton, G. E., O'Keeffe, N., Petrie, W. G., Phillips, J., Pitt, C. F., Rankine, S. M., Root, A.; Cpl./A./Sgts. Rose, S. A. W., Scarbrough, J.; Cpls. Scrivener, F. R., Seaney, W. A.; Cpl./A./Sgt. Stobart, T. D.; Cpls. Taber, W. T., Taylor, H. W. J., Thompson, A.; Cpl./A./Sgt. Thrussell, J. L.; Cpls. Waite, H. C., Woodward, P. G., Woolgar, E. C.; L./A/C./A./Sgt. Bangay, W. J.; L.A/C.s Cotton, C. W., Finch, W. J.; A/C.1 Bruford, G. R.

PROMOTION TO FLIGHT LIEUTENANT

Some time must elapse before the flow of officers from the large number of new entrants now being trained provides the number of officers at the flight lieutenant level which the expanded service requires, and special measures are necessary in the interim period. The steps which it is proposed to take are in part already known to the Service. Extensions of service are being offered to selected officers, while a large number of permanent commissions have been offered to short service and medium service officers, who are required to fill out the enlarged permanent cadre of the Air Force. Retired and reserve officers and ex-officers are being entered under civilian conditions of service for employment in administrative and specialist posts.

The balance of requirements is being met by the employment of officers at an earlier stage of their careers than hitherto in flight commander and other posts of similar responsibility. In these circumstances, the Air Council have decided, as a wholly exceptional and temporary measure, to modify for a time the conditions of promotion to flight lieutenant in the general duties branch so as largely to reduce the number of flight commander posts filled by flying officers and at the same time to shorten the period during which a flying officer is required to carry higher responsibilities before he attains higher rank.

The period of flying officer service qualifying for time promotion to flight lieutenant will therefore be reduced to three years with effect from April 1, 1936, and further reduced to two years with effect from October 1 next. The personnel eligible for time promotion to flight lieutenant will be extended to include all short service officers of the general duties branch.

The rate of pay of flight lieutenants on promotion after less than four years' service as flying officer will be 21s. 9d. per day. The hitherto normal minimum rate of 23s. 6d. per day will be issued on completion of four years' service from the date of promotion to flying officer, subject to Promotion Examination B having been passed. The increase to 25s. 4d. a day normally given after two years in the rank of flight lieutenant will not be given until two years from the date of qualification for the rate of 23s. 6d. a day.

The arrangements detailed above will be purely temporary and will be reviewed by the Air Council at a later date.

ROYAL AIR FORCE GAZETTE

London Gazette, April 21, 1936
General Duties Branch

The following are granted short service commissions as Acting Pilot Officers on probation with effect from and with seniority of April 6:—E. E. M. Angell, J. A. Bateson, J. C. Boulter (Flying Officer, R.A.F.O.), G. S. Braithwaite, P. H. E. Burke, T. F. T. Chambers, W. D. Coppinger, W. G. Craddock, S. P. Crawley, L. F. Henstock, J. E. Y. Le Moine, J. T. MacInnes, J. H. McMichael, R. D. H. Maxwell, V. Mitchell, J. E. Scoular, P. J. S. Shaughnessy.

The following Acting Pilot Officers on probation are confirmed in rank and graded as Pilot Officers (March 15):—D. K. Banks, A. L. Bocking, S. Dodds, P. F. Edinger, D. I. C. Eyres, G. V. Fryer, G. E. Hawkins, R. H. M. Heriot-Hill, P. D. R. Hutchings, B. B. Jupp, A. de V. Leach, C. M. Lester, P. A. Lombard, E. J. C. Michelmore, M. Nolan, A. B. Olney, E. F. Pippet, F. W. Richmond, J. Riley, M. H. Romer, W. R. Selkirk, R. L. Smith, E. W. Spencer, M. M. J. Stevens, F. M. Thomas, R. N. Wardell, V. E. R. Williams, J. R. Wilson.

The following Acting Pilot Officers on probation are graded as Pilot Officers on probation with effect from the dates stated:—D. H. C. Hull, P. E. A. Talbot (February 10); K. L. Ashfold, J. H. Van (February 21).

Flt. Lt. S. H. Ware is promoted to the rank of Squadron Leader with effect from April 1, and takes rank and precedence imme-

diately following Sqn. Ldr. G. R. C. Spencer in the gradation list.

The following Flying Officers are promoted to the rank of Flight Lieutenant with effect from the dates stated:—A. M. Rodgers (March 26); R. V. Alexander, J. R. Palmer, A. W. Vincent, C. L. Moncton, J. W. Bateman, R. Hanson, H. J. L. Hawkins, M. A. Payn, D. H. Marsack, W. H. Husbands, H. Pilling, G. R. Canavan, J. J. Murphy, T. P. Gleave, P. W. Johnson, G. R. Brice, J. R. S. Agar, G. F. A. Skelton, R. A. R. Rae, J. G. Glen, A. McD. Bowman, E. R. Pearce, H. R. A. Edwards, J. M. Freeman, A. L. Holland, K. R. Warton, L. J. Neale, W. M. Hargreaves, F. G. L. Smith, A. A. Adams, J. A. B. Begg, M. V. Gibbon, J. C. Larking, G. L. Best, B. A. Casey, H. W. Marlow, H. L. M. Glover, H. L. Andrews, W. S. Reed, R. T. Cazalet, F. A. Pearce, W. F. C. Hobson, W. T. H. Nichols, J. P. Cecil-Wright, H. T. Bennett, T. Q. Horner, C. S. Moore, T. N. Coslett, H. Eeles, C. M. Windsor, H. A. V. Hogan, M. W. S. Robinson, R. C. Gaskell, M. W. L'T. La V. Baker, R. L. Wilkinson, J. S. Sabine, H. G. Blair, R. G. C. Arnold, G. T. Jarman, R. I. B. Winn, R. J. Bennett, W. Pickersgill, E. W. Whitley, A. H. Marsack, K. Lea-Cox, A. L. Christian, R. H. Harris, L. S. Lamb, R. G. Shaw, A. D. Grace, W. R. Farley, F. C. Savill, F. S. Wakeham, H. Harkness, J. M. Warfield, G. Hinckley, I. V. Hue-Williams, P. A. de G. Tettenborn, J. W. A. Hunnard, E. A. Douglas-Jones, R. C. Richmond, J. D. Miller, A. W. M. Finny, S. E. R. Shepard, S. M. Moseley, P. H. Heygate, R. J. Twamley, C. N. Carpenter, J. B. Sims, W. L. Houlbrook, H. McC. White, M. D. C. Biggie, G. F. Wood, A. J. Hicks, L. C. Slee, H. R. Graham, F. W. C. Shute, R. H. Hobbs, E. A. Springall, P. H. Hamley, J. A. Dixon, W. J. Hickey, F. L. White, R. Cleland, A. V. Bax, A.F.M., D. Sloan, G. H. Denholm, F. S. Gardner, E. B. Waldy, R. N. McKern, G. A. L. Manton, N. S. Morrison, C. M. H. Outram, W. N. Elwy-Jones, R. K. Brougham, P. S. H. Ross, J. G. Cardale, H. F. Boss-Walker, G. L. Menzies, J. J. Zwarenstein, D. W. Reid, C. W. Williams, N. C. S. Rutter, A. McIlwaine, F. C. Daubney, S. C. Widdows, A. D. Messenger, H. W. A. Chesterman, F. E. Stokes, G. J. L. Read, L. F. Brown, C. W. M. Ling, W. W. Stainthorpe, W. P. Welch, D. Addenbrooke, L. V. Andrews, P. E. Drew, D. I. P. Macnair, J. O. W. Oliver, N. A. R. Halliday, R. H. Page, R. H. Younghusband, J. O. Willis, B. S. Nicholl, W. J. F. Bull, W. J. Smail, O. A. Morris, R. G. M. Apthorp, M. Hare, A. Threapleton, J. Ramsden, A. M. Carey, A. G. F. Stewart, G. E. Strangman, D. G. Keddie, W. E. Cameron, A. A. Saw, G. A. Bartlett, M. H. Dwyer, J. H. Heyworth, C. H. B. Bullock, J. M. D. Ker, J. B. Altham, J. L. H. Fletcher, E. M. Donaldson, J. W. B. Judge, R. C. Reynell, R. H. Maw, P. Bathurst, D. M. Somerville, K. F. Ferguson, W. J. H. Ekins, D. W. Baird, J. C. Sisson, Q. W. A. Ross, R. G. S. Morgan-Smith, R. Faville, S. E. MacKenzie, S. F. Godden, N. H. J. Tindal, L. F. J. Taylor, W. L. Stewart, D. Y. Feeny, P. A. Hunter, J. F. L. Zorn, G. Atkinson, J. H. A. Chapman, J. W. Donaldson (April 1).

The following Pilot Officers are promoted to the rank of Flying Officer with effect from the dates stated:—P. H. R. Saunders (March 2); R. E. Curry (March 9); B. Robinson (March 22); A. M. Mulliken, R. H. Waterhouse, K. Capel-Cure (April 1); J. A. Sutherland (April 2).

Air Marshal Sir H. C. T. Dowding, K.C.B., C.M.G., is placed on the half-pay list, scale A, from April 1 to May 31 inclusive; Lt. D. R. F. Cambell, R.N., Flt. Lt., R.A.F., ceases to be attached to the Royal Air Force on return to Naval duty (April 13); Group Capt. A. Corbett-Wilson is placed on the retired list at his own request (April 22).

Medical Branch

W. J. Fowler, L.M.S., M.D., is granted a short service commission as Flying Officer with effect from December 2, 1935, and with seniority of December 6, 1934. (Substituted for the notification in the *Gazette* of March 17); Flt. Lt. R. G. Freeman, L.R.C.P. and S., is promoted to the rank of Squadron Leader (April 14).

PRINCESS MARY'S ROYAL AIR FORCE NURSING SERVICE

Sister Miss E. K. Humphrys is appointed to the permanent service (April 1).

ROYAL AIR FORCE RESERVE

Reserve of Air Force Officers

General Duties Branch

E. J. Hill is granted a commission as Flying Officer in Class A (March 21); J. E. S. MacAlister is granted a commission as Pilot Officer in Class AA (i) (March 21); Capt. A. V. Taylor is granted a commission as Flight Lieutenant in Class C (March 16); Capt. R. S. Hellier, D.F.C., is granted a commission as Flight Lieutenant in Class C (March 18); F/O. H. G. Spearpoint is granted a commission as Flight Lieutenant in Class C (March 16).

The following are granted commissions as Flight Lieutenants in Class C:—R. Jones (March 11); D. G. Singleton (March 16).

F/O. K. W. Pell is granted the honorary rank of Flight Lieutenant while serving with the Royal Air Force as a civilian assistant (March 9).

The following Flying Officers are transferred from Class A to Class C:—R. A. Dimsdale (July 25, 1935); J. T. Hall (April 19).

F/O. H. J. Horsey relinquishes his commission on completion of service and is permitted to retain his rank (June 12, 1935).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Group Captain.—Hon. L. J. E. Twisleton-Wykeham-Fiennes, to No. 2 Bomber Group Headquarters, Abingdon; on appointment as Senior Air Staff Officer, 2.4.36.

Wing Commanders.—J. H. O. Jones, to Headquarters, R.A.F., Cranwell; for duty as Officer in Charge Administration vice Wing Cdr. E. R. Pretyman, A.F.C., 2.4.36. H. E. P. Wigglesworth, D.S.C., to D.O.I., Dept. of C.A.S., Air Ministry, 6.4.36. C. Porri, to R.A.F. Station, Farnborough; to command vice Wing Cdr. M. L. Taylor, A.F.C., 9.4.36.

Squadron Leader.—C. B. Wincott, to Special Duty List; on exchange with Royal Australian Air Force Officer, 9.4.36. A. Leach, M.C., to No. 10 Flying Training School, Tern Hill, for flying duties in Advanced Training Squadron, 13.4.36.

Flight Lieutenants.—W. H. Kyle, to Special Duty List; on exchange with Royal Australian Air Force Officer, 3.4.36. G. K. Tulloch, to Anti-Aircraft Co-operation Flight, Biggin Hill, 6.4.36. J. A. T. Ryde, A.F.C., to D.T.D., Dept. of A.M.R.D., Air Ministry, 9.4.36.

Flying Officer.—F. B. Bristow, to No. 215 (B) Squadron, Upper Heyford, 3.4.36.

Pilot Officers.—A. F. Bandidt and J. G. Munro, to Anti-Aircraft Co-operation Flight, Biggin Hill, 6.4.36. N. W. Wright, to Air Observers' School, North Coates Fitties, 14.4.36.

Acting Pilot Officers.—The undermentioned are posted to No. 9 Flying Training School, Thornaby, with effect from 4.4.36:—J. A. Coltart, A. L. Doran, C. J. C. Lee, A. W. Pennington-Legh, A. S. K. Scarf, J. G. Theilmann, A. O. Bridgman, G. Harris, R. D. Speare, L. S. Dawson, P. M. Brothers, L. G. Hamer, W. S. Pryde, H. A. 'B. Russell, W. T. C. Seale, H. L. Smeddle, J. R. Sullivan, E. C. Wolfe, S. T. Meares, K. J. Powell, J. P. Wells, T. D. B. Blake, E. C. S. Fewtrell, E. A. Keegan, D. R. Miller, J. D. Stern, R. A. Barton, and G. R. E. Gregory. J. W. S. Forbes, to Air Observers' School, North Coates Fitties, 14.4.36. S. H. Kernaghan, to No. 9 Flying Training School, Thornaby, 6.4.36.

The undermentioned are posted to the R.A.F. Depot, Uxbridge, on appointment to short service commissions with effect from the dates indicated:—

March 30, 1936

J. S. Adams, A. S. B. Blomfield, G. V. Cook, W. C. S. A. G. Cooper, D. R. Hopper, B. P. Jones, J. A. W. Lawrence, P. E. Torkington-Leech, B. E. R. Bowden, C. A. Butler, W. G. Oldbury, D. St. Q. Robinson, G. V. Smither, R. D. Tate, H. P. Blatchford, S. McC. Boal, A. M. Brown, J. A. Crockett, H. M. Crump, J. M. Griffith-Jones, B. MacCallum, D. F. Spotswood, P. F. R. Vaillant, C. P. Bomford, P. G. Chapman, J. H. Coghlan, H. Henry-May, D. B. Hobson, E. C. Inglefield, E. J. S. Jones, J. S. Kendrick, P. D'A. Lister, and P. H. R. R. Terry.

April 1, 1936

F. D. D. Jones.

April 3, 1936

R. L. Lorimer and J. P. S. Packer.

April 6, 1936

E. E. M. Angell, J. C. Boulter, P. H. E. Burke, W. D. Coppinger, S. P. Crawley, J. E. V. Le Moine, J. H. McMichael, V. Mitchell, J. E. Scoular, J. A. Bateson, G. S. Braithwaite, T. F. T. Chambers, W. G. Craddock, L. F. Henstock, J. T. MacInnes, R. D. H. Maxwell, and P. J. S. Shaughnessy.

Commissioned Engineer Officers

Flying Officers.—H. R. Clowes, to Headquarters, Coastal Area, Lee-on-the-Solent; on appointment to a permanent commission as Flying Officer—Commissioned Engineer Officer—on probation, 30.3.36.

F. C. Crowdy, to Administrative Wing, Cranwell, 14.4.36.

Flying Officers.—The undermentioned are posted to the Units shown on appointment to permanent commissions as Flying Officers (Commissioned Engineer Officers) on probation with effect from 14.4.36:—E. L. Magrath, to R.A.F. Station, Aldergrove; J. C. Steadman, to R.A.F. Station, Boscombe Down.

Accountant Branch

Flight Lieutenant.—B. L. Blofeld, to Headquarters, Coastal Area, Lee-on-the-Solent, 14.4.36.

Medical Branch

Flight Lieutenants.—G. W. McAleer, to Medical Training Depot, Halton, 14.4.36. C. G. Harold, to Central Medical Establishment, London, 16.4.36.

Flying Officer.—F. W. Whitehead, to Medical Training Depot, Halton, on appointment to a short service commission, 29.3.36.

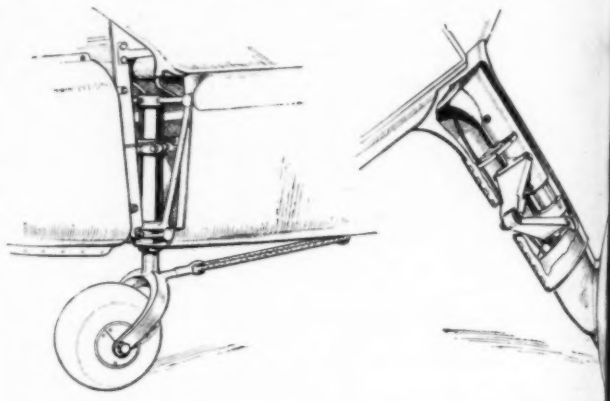
PERFORMANCE from AMERICA

The Cessna C-34 Comes to England : Four People Cruise at 143 m.p.h.

The clean lines of the Cessna are admirably shown in this flying picture taken near Croydon. (*Flight* photograph.)

WHEN the performance figures of the American Cessna C-34 monoplane were first learnt in this country a good many people either frankly disbelieved them or suggested that such figures were only to be obtained at the expense of other and more desirable features. A maximum speed of 162 m.p.h. while carrying a disposable load of 920 lb. on a mere 145 h.p. certainly appeared to demand a little close investigation and, when it was learnt that Surrey Flying Services, of Croydon, had obtained the British and European rights for the machine, and that Mr. S. L. Turner had bought the first example and was bringing it over, various charter pilots and others promised themselves a trip at the first available opportunity.

The machine is now here with an English C. of A., and it has already done quite a lot of high-speed flying. Pilots with Anglicised ideas of flying qualities have learnt to appreciate those of the Cessna, and even people who were mildly disturbed by certain characteristics have at least had to admit that the machine does cruise at an indicated 145 m.p.h. or so without loss of height, and that it is, withal, a very pretty aeroplane. Apart entirely from the typically perfect finish, the Cessna's looks may help to sell it, and a good appearance is rather more important than some hard-headed persons might imagine. Examine the Cessna from directly ahead and it is not at all difficult to understand the reason for the high speed obtained with such a comparatively low power. A cantilever wing, a cantilever undercarriage with streamline tyres, and N.A.C.A. cowling with pressure baffling for the engine leave very little to the imagination.



The self-centring tail wheel (left) is sprung and damped. On the right is one of the cantilever undercarriage legs with the fairing cut away to show the means used to prevent the lower portion of the leg from turning in relation to the main body.

Of mixed construction, the C-34 has a wooden wing, with spruce spars and plywood-covered leading edge and wing tips, and a welded-steel tubular fuselage. The divided full-cantilever undercarriage has oil-spring shock absorbers and 6in. of vertical travel, while the tail wheel is similarly sprung and damped. The Warner Super-Scarab radial delivers its power at the comparatively low speed of 2,050 r.p.m.

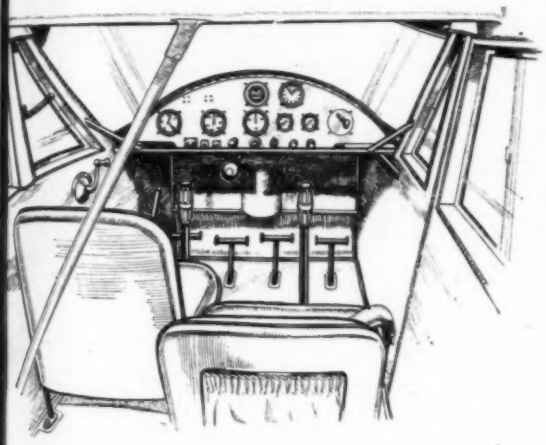
With such a machine trailing-edge flaps are an absolute necessity, and those of the Cessna are manually operated through a bevel-gearing system. Fore and aft trim-

Fully cowled and pressure-baffled, the installation of the Warner Super-Scarab is extremely interesting. Note the streamline tyres. (*Flight* photograph.)

ming is carried out by means of elevator tabs operated by a small and conveniently placed handle on the left of the pilot. Full dual control for the side-by-side forward seats is part of the standard equipment, which includes navigation lights, an electric starter and, for the European market, a Reid and Sigrist turn indicator. Such special instruments as a Kollsman sensitive altimeter are naturally part of the list of "extras," which, when the machine is to be used as a fast charter type, includes such items as Grimes retractable landing lights and bonding and shielding for wireless installation. A very wide series of two-colour finishes are available at the standard price, though an additional sum is charged for white or lemon yellow, which demand additional coats with intermediate rubbing-down.

Internal Features

The cabin seats four people, and there is a small luggage locker at the rear, behind the squab. The single door provides easy access to the rear seats, but to reach those in the front it is necessary to slide back the off-side seat. At first, the newcomer gains the impression that the forward accommodation is cramped, but after an hour or so in the air this impression is, to a large extent, lost. The

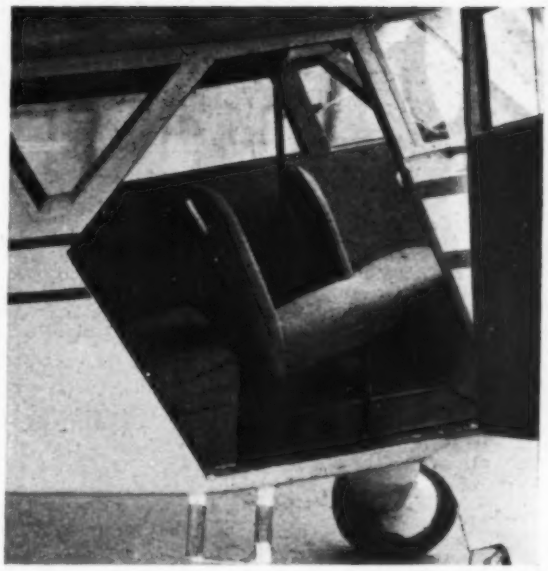


In this interior view the standard equipment is shown. The small window on the left can be opened.

fact is that with a spar behind one's head and a rail across the dashboard the more sensitive person suffers from a feeling of claustrophobia, and this is inaccurately judged as lack of body space. With no emergency exit these forward occupants might, however, have some difficulty in removing themselves in case of accident.

While in flight the view in essential directions is good, since the nose is well down while travelling at cruising speed. It is not possible to see to the rear before making a turn near a crowded aerodrome, though one can cover quite a wide area by making use of the cabin windows while entering the turn. However, there are not many machines which are likely to be overtaking, and the phenomenal climb will take the Cessna away from almost anything else during a departure. As in the case of the majority of machines, the general view improves, so to speak, as the machine is better known.

Pilots who are accustomed to the characteristics of British machines will make a number of interesting discoveries when flying the C-34. The take-off is perfectly normal, but the climb is so steep that an effort is required to point the nose as high as it should be, and the machine virtually flies itself when trimmed for level cruising. At this speed the controls are good, though a trifle heavy, but when gliding at 80 m.p.h. one's first impression is that the stall is near since the ailerons are weak.



To be examined in conjunction with the interior sketch, this picture shows how the offside seat is slid back for entry to the pilots' seats. (*Flight* photograph.)

In actual fact the machine is perfectly safe and under some control right down to the real stall, which takes place at about 50 m.p.h., and the only point to remember is that the final approach must be made in a straight line and properly into wind. With such a clean machine it is naturally essential to watch the gliding speed, which can rise very quickly indeed, even when the flaps are down. Quite a lot of work is required to depress these to their fullest extent; this has an advantage inasmuch as the careless pilot is given time to think seriously of such things as gliding speeds and gliding trim—which change somewhat as the flaps are lowered.

CESSNA C-34 CABIN MONOPLANE
145 h.p. Warner Super-Scarab

Weight empty	1,309 lb. (*591 kgs.*)
Disposable load	920 lb. (*418 kgs.*)
Maximum speed	162 m.p.h. (*259 km/hr.*)
Cruising speed	143 m.p.h. (*229 km/hr.*)
Landing speed (flaps down)	47 m.p.h. (*76 km/hr.*)
Initial climb	1,000 ft./min. (*308 m.*)
Cruising range	550 miles (*880 kms.*)
Service ceiling	18,900 ft. (*5760 m.*)
Price	£1,375

So far as rate of descent is concerned, on one approach with full tanks and with three people aboard we passed the Croydon Hotel with a burst of engine at about eighty feet at 80 m.p.h., and still put down on the edge of the tarmac. The actual landing is done by the machine, and one does not hold off and haul everything back in the accepted manner. One's impression is that the elevators are merely being used to check the sink as the ground is approached. This, of course, is merely an impression, and the actual facts are probably rather different. There is, however, very little in the approach and landing once the machine is understood.

In the matter of performance it is only possible to talk of indicated speeds. With the revolution counter showing 1,700 r.p.m. and the Kollsman sensitive altimeter indicating neither climb nor descent, the A.S.I. showed a steady 143-145 m.p.h. Since the machine landed just off the clock (50 m.p.h.) with two persons on board there is no reason to suppose that the instrument was reading high.

ANOTHER "PUSHER" REVIVAL

The Dunstable Dart, a New Single-seater Ultra-light Parasol Monoplane

HISTORY has a curious habit of repeating itself. Some of the earliest aeroplanes had the pilot seated in front of the wings and the engine and airscrew behind them. Then one or two pioneers, Mr. (now Sir Alliott) A. V. Roe among them, discovered that the tractor type was more efficient, and in a few years the single-engined "pusher" had disappeared.

There were several reasons for the early pusher being less efficient, aerodynamically, than the tractor. The tail was carried on an open-work girder which offered considerable air drag by reason of its struts and criss-cross wire bracing. Secondly, with the airscrew being behind the trailing edge of the wings, a fairly tall undercarriage was necessary to give sufficient ground clearance for the airscrew and still have the necessary ground angle on the wings.

In modern times, the pusher can be made a good deal more efficient than was the pusher of the early flying days, although the difference in efficiency between pusher and tractor is probably at least as great as ever it was, owing to the progress made in design. Efficiency is not, however, the only desirable feature of an aircraft, and if a small degree of performance is sacrificed, several very pleasant and desirable features can be obtained in exchange. In this connection it is interesting to recall that several of the private owners who contributed their views to *Flight* last week did not lay great stress on performance.

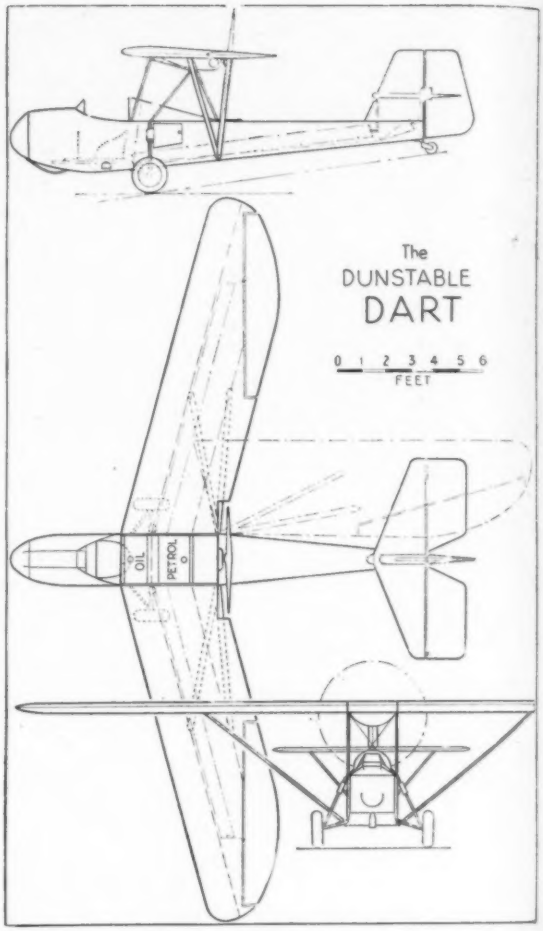
Precedent

An interesting new pusher monoplane is now being built at the Dunstable works of Dart Aircraft, Ltd., who were formerly known as Zander and Weyl. As the general arrangement drawings show, the new Dart single-seater resembles somewhat the little monoplane which Mr. Lee Murray and Mr. W. S Shackleton produced some years ago. The S.M.1 was, however, a two-seater, while the Dart is a single-seater. Also, the Dart shows a pronounced sweep-back of its wings, while the S.M.1 had straight wings.

The parasol wing arrangement was chosen largely because it enables the petrol tank to be carried in the centre-section and so provides direct gravity feed. The sweep-back was incorporated to increase stability, and also helps in that the machine can be made to trim properly without a very long nose to carry the pilot. The very low position of the fuselage, and the fitting of a skid under the nose, should make it almost impossible to turn the machine over when landing on rough ground. In this connection it would appear from the drawings that the wheels are a little far forward and that as a result there may be some delay in "getting the tail up." Doubtless this placing of the wheels was chosen after due consideration, and will probably be offset by the high position of the thrust line, which will help to raise the tail.

While on the subject of the thrust line, attention may be drawn to the fact that the engine is so mounted that the slipstream is directed on to the tailplane. When the engine stops, the disappearance of the slipstream is expected to result in a reduction of the down-load on the tail, thereby preventing any tendency of the machine to stall.

From a structural point of view the Dunstable Dart is a very simple piece of work, wood being the chief material. The fuselage is a flat-sided box, and the wing is of orthodox construction, with the box-section front spar and the ply-covered



leading edge forming a D-section tube, very strong in torsion. The rear spar is placed fairly far back in the wing section, and carries large ailerons.

A remarkably good view should be obtained from the pilot's seat, and owing to the proximity to the ground he should have little difficulty in judging his landings. The seat is adjustable in a fore-and-aft direction. In this way a certain degree of automatic trimming should also be obtained, assuming that a tall pilot will also be a heavy pilot and the rearward position of the seat helping to shift the c.g. back.

The first machine, which is expected to be flying in a few weeks, will be fitted with a 34 h.p. Bristol Cherub engine, but as this unit is no longer being manufactured, alternative engines of approximately the same power and weight can be fitted.

With an overall wing span of 29ft. 7½in. the wing area is 114 sq. ft. When the wings are folded the width is reduced to 10ft., and the length is then approximately 24ft., so that the machine can be stored in a shed measuring 12ft. × 25ft.

The estimated tare weight of the Dart is 485 lb. and the gross weight 700lb., leaving 215lb. for disposable load (pilot, luggage and fuel). The estimated top speed is 87 m.p.h. and the gliding speed, near the ground, 31 m.p.h. The price at which the Dart will be marketed has not been decided yet.

R.Ae.S. AWARDS

AT a meeting of the Council of the Royal Aeronautical Society held on April 21 the following awards were made:

Silver Medal of the Society.—Mr. B. N. Wallis, for his work on Geodetic Construction.

Simms Gold Medal.—Mr. W. S. Farren, M.B.E., M.A., M.I.Ae.E., F.R.Ae.S., for his inventions of new methods of the measurement of drag and his designs of scientific apparatus for aeronautical research.

Taylor Gold Medal.—Mr. E. F. Relf, A.R.S.Sc., F.R.Ae.S., for his paper, read before the Society, on the Compressed Air Tunnel.

Sir Charles Wakefield Gold Medal.—Mr. C. R. Fairey, M.B.E., F.R.Ae.S., for his work on the development of flaps.

Busk Memorial Prize.—Mr. R. P. Alston, B.A., A.F.R.Ae.S., for his paper, read before the Society, on wing flaps and other aids to landing.

COMFORTABLY FAST

James Melrose Takes the First Production Heston Phœnix Home to Australia in Sixteen Days

AFTER about three hours' test flying the first production type Heston Phœnix (D.H. Gipsy Six, 200 h.p.) left Heston for Australia on April 9. At the controls was Mr. James Melrose, in the cabin and locker were emergency provisions and a collapsible dinghy, and on the fuselage were the registration letters VH—AJM and the machine's name, *Billing*—which has a family significance so far as the pilot is concerned, for he is a nephew of Mr. Noel Pemberton Billing. One other point of difference from the familiar prototype Phœnix was the provision on the Dowty undercarriage of hydraulic locks for the "up" and "down" positions. This improvement will be incorporated in all subsequent Phœnixs or Phœnices.

Having made the 12,000 mile trip in quiet luxury and having written a five-page letter to Heston while in the air, Melrose put the Phœnix down at Adelaide on April 29. The following gives some idea of his itinerary: Marseilles (April 9), Baghdad (13th), Karachi (15th), Rangoon (17th), Singapore (19th), Darwin (22nd).

Accessories and equipment included: B.T.H. magnetos, Claudel Hobson carburetters, Lodge plugs, Fairey airscrew, Dunlop wheels and hydraulic brakes, Dowty undercarriage and tailwheel, Rumbold furnishing and soundproofing, Titanine dope, Smith's instruments, R.T.E. homing equipment and receiver, and Shell fuel and oil.

Mr. Melrose and the Phœnix

A Marendaz Acquisition

THE rights for the A.B.C. Scorpion II 40 h.p. light aero engine have been acquired by Marendaz Special Cars. This engine, which is claimed to be the only one in its category to have been type-tested, should be suitable for high-performance *Poux* and the larger ultra-light aircraft.

Poux and Pork Pies

IN conjunction with Carden Aero Engines, Ltd., the Leicestershire Flying Pou Co., Ltd., is holding a *Pou-du-Ciel* demonstration and rally at its Aerodrome at Sandys Lane, Melton Mowbray, Leicestershire, this week-end, the event extending over the Saturday and Sunday. Mr. S. V. Appleby, it is announced, will be flying his own *Pou*, and it is hoped that as many light aircraft owners as possible will attend.

R.Ae.C. Chairman and Vice-chairman

MR. W. LINDSAY EVERARD, M.P., has been elected chairman of the Royal Aero Club for 1936, and Mr. F. Handley Page, C.B.E., vice-chairman.

The club has also elected the following stewards: The Duke of Atholl, K.T.; Lord Hugh Cecil, M.P.; Lord Cozens Hardy; the Marquess of Londonderry, K.G., P.C., M.V.O.; Lt. Col. Sir Francis K. McClean, A.F.C.; Lt. Col. M. O'Gorman, C.B.; Col. Sir Joseph Reed; Lt. Col. Sir Francis C. Shelmerdine, C.I.E., O.B.E.

The Modern Air Ambulance

"GREAT Britain is many years behind other countries in the organisation of air ambulance work," declared Mr. S. J. Noel-Brown—who, apart from being well known in the aircraft industry, is assistant Surrey county secretary for air of the British Red Cross Society—when speaking at Wimbledon last Monday night. "France, Sweden, Italy, Poland and the U.S.A. all have air ambulance organisations, but in this country we have practically nothing."

"It is only now that one of the aircraft firms, specialising in civil machines, is completing the first British machine to be built solely as a flying hospital. It will enable valuable hours to be saved in the transport of sick and injured persons, as well as allowing them to be moved under the most comfortable conditions and even where the time factor does not mean the actual saving of life, it will avoid much pain and suffering. The new flying hospital will have not only complete medical nursing equipment, but will include blood transfusion apparatus and an oxygen tent.

"In the formation of the Air Ambulance Detachment, the British Red Cross Society has given a strong lead. The fighting services should equip their medical units with air ambulances, and on the civil side every municipal authority possessing its own aerodrome should also have its own air ambulance unit."

Twenty-five Years of Wireless

TO the majority of people, wireless in general, as apart from aircraft radio, seems a very modern development, yet it goes back quite a long way. That this is so is proved by the May 1 issue of our associated journal, *The Wireless World*, which this week celebrates its twenty-fifth year.

The Wireless World was the first wireless journal to be founded, and made its appearance long before broadcasting or even radio telephony were thought of.

One of the features of the May 1 issue, which will specially attract everyone interested in wireless, is a "Cavalcade of Wireless," shown in extracts, in word and picture, from successive year-by-year issues of *The Wireless World*.

The R.Ae.S. Garden Party

TWO dozen widely assorted civil and military aeroplanes, ranging from *Poux-du-Ciel* to the Fairey Battle, and including Mr. G. J. Nash's restored war-time Camel, will be put through their paces before members of the Royal Aeronautical Society at the annual garden party at the Fairey Aerodrome on Sunday, May 10. They will include:—

Abbott Baynes *Pou-de-Ciel* and auxiliary Sailplane; Blackburn B.2 Trainer; B.A.C. Super Drone; B.A. Eagle and Swallow; C.30 Autogiro; De Havilland Hornet Moth and Dragonfly; Fairey Battle and Swordfish; General Aircraft De Luxe, Ambulance and S.T.18 Monospars; Mr. R. G. J. Nash (International Horseless Carriage Corporation) Sopwith Camel; Aeronca-J.A.P. and low-wing Aeronca; Percival Vega Gull; Puttnam *Pou-de-Ciel*; Miles Falcon Six and Sparrowhawk; Avro Staggered Cadet; Saro Cloud; Short Scion; Stinson Junior; Tipsy S. monoplane.

The programme lasts from 2.30 p.m. to 7 p.m., and in addition to the machine demonstrations specified above will include an exhibition of towed gliding, a parachute jump, and a fire-fighting demonstration.

This year admission will not be confined to members, but the organisers emphasise that early application must be made for tickets (price 5s.)—actually by next Thursday, May 7, at the very latest.

The Fairey Aerodrome is situated at Harmondsworth, which lies a little to the west of the Great West Road Extension connecting the Bath and Staines roads.

THE INDUSTRY

Aviation Trust Joins Fixed Trust Association

IT was officially announced last week that Aviation and Universal Investment Trust, which specialises in the aviation and allied industries investment field, has been elected a member of the Association of Fixed Trust Managers. Lord Sempill is chairman of the board of the management company of Aviation and Universal Investment Trust.

Simplifying Service

WHAT must be one of the most comprehensive service and replacement schedules—and certainly the most comprehensive that we have seen—has recently been produced by General Aircraft, Ltd., for Monospar machines.

A complete and carefully indexed price list of all the spare parts, raw materials and instruments, each with its appropriate ordering number, is prefaced by a list of the approved agents, both at home and abroad, for machine, engine and accessory service. Machine agents are to be found as far afield as Australia and the Argentine, while the detail agents include those for Dunlop and Palmer, Radio Transmission Equipment, Smith's instruments, and Rotax electrical equipment. In all, the list of agents covers twelve pages, and the spares and replacement list a matter of fifty-nine.

Hillson Praga Issue

THE subscription list opened yesterday for the sale of 600,000 ordinary shares of 4s. each at 5s. 3d. per share in F. Hills and Sons, Ltd., of Stockton-on-Tees, who are building the Praga light cabin two-seater in this country, and are sole concessionnaires for it in the British Empire.

With the appearance of the prospectus it is now possible to disclose the fact that a flat-twin engine specially built by the makers of the Jowett car is to be fitted to these machines.

Apart from the Company's joinery work, which showed a profit of £17,044 last year, good business with the Hillson Praga is anticipated. Orders for forty have been received. The plant has a production capacity of 200 machines for 1936, rising to 1,000 thereafter. The Hillson Praga, it will be remembered, sells at £385, a figure which, it is stated, proves profitable under mass production.

A British Lorraine Engine

AIRCRAFT manufacturing prospects in the Coventry district formed the subject of reports made last Tuesday by sub-committees to the Coventry City Council.

Briefly, the committees recommend that land be leased to the Alvis Company at Baginton—alongside the aerodrome—for production testing of their engines; that land be sold to Copper Sheets, Ltd., for the erection of a factory at Canley; and that an option be granted to British Lorraine Aircraft, Ltd., for the purchase of about ten acres of land at Stoneleigh.

The last-mentioned item is particularly interesting. The company named is now in process of formation, and will presumably manufacture types based on some or all of the French Lorraine units, such as the 760 h.p. vee-twelve Petrel, the 950-1,100 h.p. vee-twelve Eider, the 980-1,100 h.p. "broad arrow" twelve-cylinder Orion, and the air cooled radials such as the nine-cylinder 370 h.p. Algol.

The Stockholm Show

THIRTEEN countries will, it is expected, be represented at the international aero show ("I.L.I.S.") to be held in Stockholm from May 15 to June 1, 1936. They are: Great Britain, Belgium, Canada, Denmark, Finland, France, Holland, Czechoslovakia, Norway, Poland, Switzerland, Sweden and Germany. British firms will include the following aero engine makers: Armstrong Siddeley, Bristol, De Havilland, Napier, Pobjoy, Rolls-Royce and Wolseley. Handley Page and Percival will exhibit aircraft, and among British equipment and accessories firms are to be found such familiar names as Dunlop, Palmer, Short and Mason, Smith's Aircraft Instruments, Standard Telephones, and Wellworthy.

Germany has taken a very large space, and it is expected that the German exhibits will dominate the show. Fokker will show a single-seater fighter, and Finland and Poland will exhibit small machines. A large number of British private owners are expected, and landing and housing fees will be abolished during the period of the exhibition.

On May 24 the new Stockholm airport at Bromma will be officially opened, and at the same time the competitors in the Nordic Air Races are due at the aerodrome.

The Aeronautical Corporation Issue

AN issue of 560,000 shares of 5s. each at par was made last Tuesday on behalf of the Aeronautical Corporation of Great Britain, Ltd. The principal objects of the new company are, briefly, as follows: (1) To acquire from Light Aircraft, Ltd., of 7, Park Lane, London, W.1, exclusive licences to manufacture and sell within the British Empire and Europe the two-seater side-by-side cabin aeroplane known as the Aeronca, together with the assets of that Company, including the drawings and specifications, jigs and tools, and the benefit of the research and experimental work which it has carried out, and of all pending contracts. This machine will be fitted with an engine to be manufactured on behalf of the Company by J. A. Prestwich and Co., Ltd., the manufacturers of the well-known J.A.P. engine, and will be sold under the name of Aeronca-J.A.P.

(2) To acquire from Lang Propellers, Ltd., of 7, Park Lane, London, W.1, the whole of its assets, comprising rights under British Patent No. 397,513, and two applications for patents, including an application relating to machines for shaping airscrew blades applied for by Mr. A. A. D. Lang, and also certain plant and machinery.

(3) To acquire from Aircraft Accessories, Ltd., of 3, Gray's Inn Place, London, W.C.1, a well-equipped freehold factory adjoining the London and North Eastern Railway Company's main line at Peterborough.

The Aeronca side-by-side cabin two-seater needs no introduction to readers of *Flight*. As regards Lang Propellers, Ltd., Mr. A. A. D. Lang, whose experience of airscrew manufacture dates from pre-war days, and who established two airscrew factories for Government work in the United States, has recently developed an improved design of machine for shaping blades by the use of which, it is believed, the cost of manufacture by existing processes will be reduced. Mr. Lang's process is also applicable to the manufacture of metal airscrews.

The Peterborough factory referred to above was erected and fitted by Frederick Sage and Co., Ltd., during the war for the construction under contract of military aircraft. The works are capable of turning out fifteen aircraft a week. Since the war Frederick Sage and Co., Ltd., have continued to use the factory for their own trade of shopfitters. It is equipped with wood-turning and other machinery well adapted to the production of Aeronca-J.A.P. machines and Lang Propellers, to be commenced with a minimum of delay.

It is also intended to utilise the works for the manufacture of aircraft parts, so that sub-contract and other work may be undertaken.

NEW COMPANIES

In the notes below, for reasons of space, the "objects" of new companies are usually somewhat abbreviated.

INTEGRAL AUXILIARY EQUIPMENT LIMITED. Registered as a private company on April 17, with a nominal capital of £25,000 in 24,000 preferred ordinary shares of £1 each and 20,000 deferred ordinary shares of 1s. each. Objects: to carry on the business of designers, patentees and manufacturers of aeroplanes, seaplanes, flying boats, etc. The directors are: Hugh Burroughes, Sidbury Lodge, Edgware, Middlesex; Trevor P. Searight, 69, Piccadilly, London, W.1; Thos. E. Beacham, 89, Gunnersbury Avenue, Ealing, Middlesex; and Edward Dodson, 66, Lewin Road, Streatham.

H. Burroughes, T. P. Searight and E. Dodson are also directors of H. M. Hobson (Aircraft and Motor) Components, Ltd. Registered office: 47, The Vale, Acton, W.3.

NORTH OF IRELAND AERO CLUB LTD. Private company, registered in Belfast, April 8. Capital, £3,000 in £1 shares. Objects: to permit the pursuit of aviation; to provide facilities for instructional and sporting flights, etc. The subscribers are Lancelot J. Turtle, 17 21, Castle Place, Belfast; Gerald F. Annesley, Castlewellan; Miss E. F. Kathleen McCormick, Cultra House; and six others. The first directors are not named. Secretary: H. M. Pollock. Registered office: Ards Airport, Newtownards, Co. Down.

TRANSMISSION PATENTS LTD. Private company, registered April 22. Capital, £100 in 2s. shares. Objects: To carry on the business of aero, automobile electrical and general engineers, etc. The directors are: James H. Mills, 79, Lombard Street, Birmingham; Levi J. F. Austin. Registered office: 21, Bennetts Hill, Birmingham.

AMALGAMATED AIRCRAFT BUILDERS LTD. was registered as a private company on April 20, with a nominal capital of £100 in £1 shares. Objects are to carry on business as aeronautical experts and consultants, manufacturers of and dealers in aeroplanes, seaplanes, etc. The first directors are to be appointed by the subscribers. Registered office: 7, Laurence Pountney Hill, London, E.C.

AIR-ROADS AND PATENTS LIMITED. Registered as a private company on April 20 with a nominal capital of £1,500 in £1 shares. Objects: to carry on the business of manufacturers of and dealers in aircraft and component parts thereof, etc. The directors are: Lord Patrick Crichton Stuart, 11, Eccleston Place, London, S.W.1, motor agent; John G. D. Armour, 31, Nottingham Place, London, N.W.1, professional pilot. Registered office is at 8, Henrietta Street, London, W.C.2.

AERONAUTICAL PATENT SPECIFICATIONS

(The numbers in brackets are those under which the Specifications will be printed and abridged, etc.).

Published, April 30, 1936.

30979. RUBBRA, A. A.: Gun-actuating means for aircraft (444,912).
13537. KNOLLER, E.: Means for mounting in an aircraft the motor to which a gun-barrel is secured (444,991).
16033. DUBOIS, R.: Doors for aeroplanes, motor cars, and other vehicles (444,994).
30815. WARD, C. F.: Vehicle and aircraft bodies (445,093).

Boy's Life